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EDITED BY THURSTON SCOTT WELTON, M.D.

April 1943

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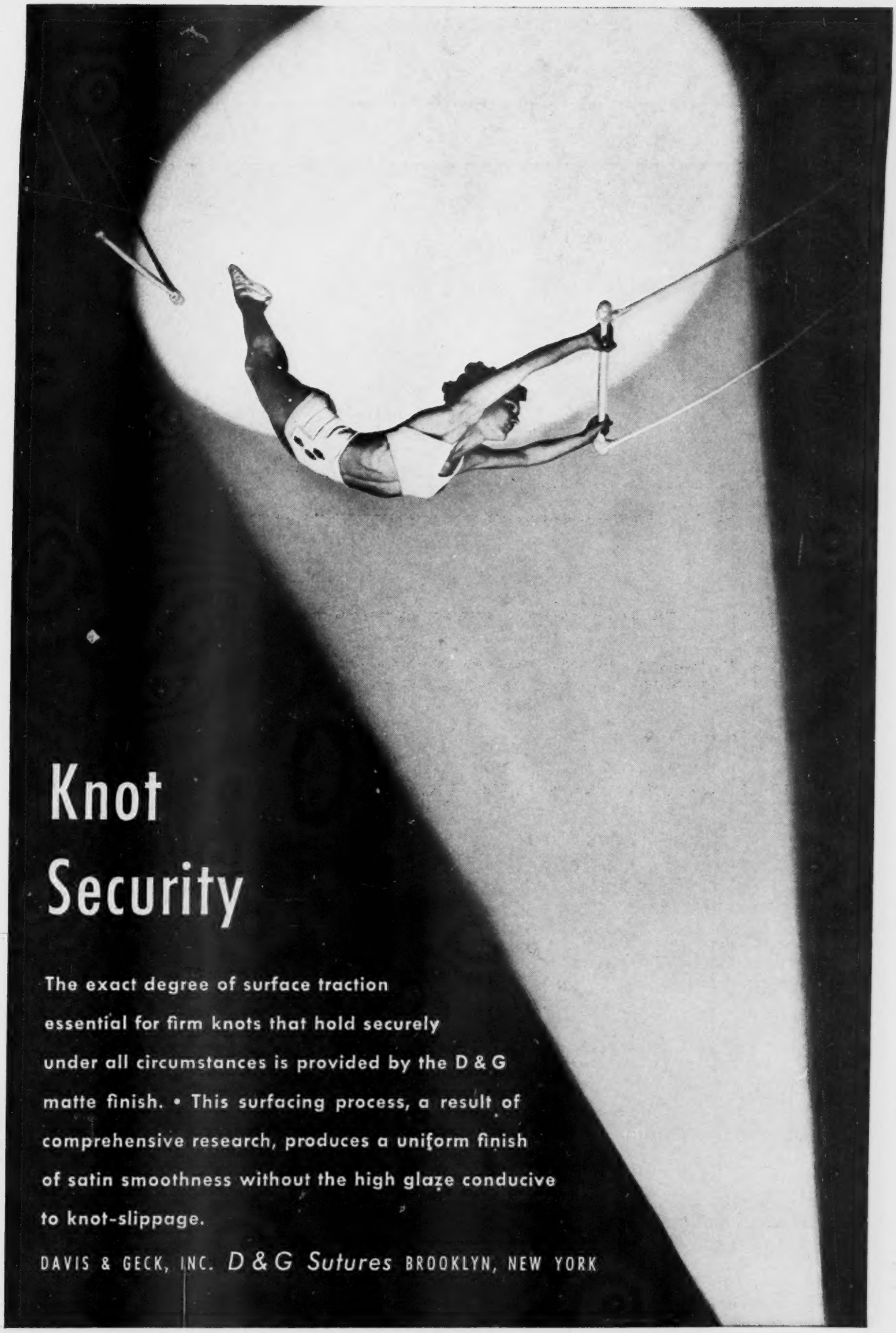

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Within fat there is a thin layer of subcutaneous connective tissue which should be sutured whenever possible. Its repair provides extra strength for the wound and aids in maintaining hemostasis. This layer is usually hidden in the fat where it can only be located by means of forceps. It lies immediately subjacent to the skin when the subcutaneous fat is absent.

In general, two plans have been adopted to obliterate dead space without damaging the fat. Either tension sutures are employed or the subcutaneous connective tissue layer is approximated with very fine sutures.

The former plan is usually employed when the subcutaneous fat is very thick. When the subcutaneous fat is meager in amount, the connective tissue layer may be included in the bite of the skin suture. In all other circumstances separate suturing of the connective tissue layer is usually employed.

If the buried suture causes damage to fat, exudation and induration take place during the healing process. Sizes larger than No. 00 cause these changes plus tenderness and a discharge of clear fluid from the wound on the seventh to the tenth day of healing. The frequency of this complication with the larger sizes of buried sutures undoubtedly is the reason why some prefer to use tension sutures instead. However, when sizes No. 0000 or No. 00000 are employed as interrupted buried sutures in the subcutaneous fat, excellent healing is obtained. These sizes cause only minimal damage to the fat, yet they satisfactorily obliterate dead space and provide additional strength for the wound.

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Editorials

Abdominal Surgery . . . . . *Malcom Thompson* 1
Postoperative Use of Sulfonamides . . . . . *George C. Foster* 2

Original Articles

Foreign Body Localization and Extraction. Description of a Method More Accurate Than That Used by the Army . . . . . *Lewis Gregory Cole* 3
Early Laminectomy for Spinal Cord Injury Not Due to Subluxation . . . . *Foster Kennedy, Peter G. Denker and Raymond Osborne* 13
Multiple Carcinoma. The Clinical Picture, Diagnosis and Prognosis . . . . *Hugo Hellendall* 22

Contents Continued on Page 3

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NEW SERIES VOL. LX — NUMBER ONE

Contents • April, 1943

Tumors in the Region of the Cauda Equina. A Review of Twenty-five Cases . *Ira Cohen and Lieut. Commander Abraham Kaplan* 36
Internal Fixation Device for the Treatment of Intertrochanteric Fractures of the Femur . . . *Herbert H. Thatcher* 44
Fallacies of Bone Plating . . . *R. D. Joldersma* 50
Study of the Uterine Canal by Direct Observation and Uterogram . . . *W. B. Norment* 56
Anesthetic Deaths. A Five-year Report . . . *Frank N. Dealy* 63
Supernumerary Breasts. With Special Reference to the Pseudomamma Type . *Captain Leo R. Weinshel and First Lieut. Nicholas Demakopoulos* 76
Littré's Umbilical Hernia. Case Report . . . *W. Edwin Bird* 81
Exploration of the Common Bile Duct. Review of 165 Cases . . . *Captain Donald H. Hooker* 88
Complications of Thyroid Surgery. Anatomy of the Recurrent Laryngeal Nerve, Middle Thyroid Vein and Inferior Thyroid Artery . . . *Carl A. Bachhuber* 96
Complete Reconstruction of Auricle . . . *Morton I. Berson* 101
Sulfathiazole Anuria Cured by Decapsulation of the Kidneys. Case Report . *M. L. Weinstein and E. Lawrence Adams* 105
Treatment of Shock and Fresh Wounds . . . *Henry H. Ritter* 112

Case Reports

Sacrococcygeal Chordoma. Report of a Case . . . *Louis Olsman and Maurice Lev* 115
Acute Perforation of a Diverticulum of the Sigmoid. Treatment by Operation and Sulfanilamide . . . *Charles Haines* 119
Surgical Treatment of Medical Jaundice. Case Report . *Dean Macdonald and H. Raymond Drysdale* 122
Multiple Primary Neoplasm of the Colon . . . *John Herrlin, Jr. and Walter L. Mersheimer* 126
Brucella Spondylitis. Case Report . . . *Martin Dobelle* 130
Cavernous Hemangioma of the Skull. Case Report . *Dean H. Echols and Captain L. R. J. Kleinsasser* 134
Excision of the Duodenum and Head of the Pancreas for Carcinoma of the Ampulla. Method of Anastomosing Pancreatic Duct to the Jejunum . . . *John Roberts Phillips* 137
Pedunculated Ovarian Cysts in Children. An Aid to Diagnosis . *L. M. Rankin and S. A. Eger* 140
Rupture of the Normal Cecum Resulting from Malignant Obstruction of the Splenic Colon . . . *Gilbert B. Tepper and Theodore B. Massell* 142
Multiple Argentaffinomas in Ileum with Metastases in Lymph Nodes and in the Liver . . . *I. Roy Gold and David M. Grayzel* 144
Amputation of a Buttock for Eradication of a Cavernous Hemangioma . . . *James B. Weaver and Mervin J. Rumold* 149

New Instruments

Inexpensive Electric Drill, Saw and Kirschner Wire Drill Guide . . . *W. Compere Basom and Louis W. Breck* 151
Positive Shoulder Lift for Fractured Clavicles . . . *H. C. Masland* 154
Selected Book Reviews . . . 156

General Information on Page 4 *Advertising Index on 3rd cover*

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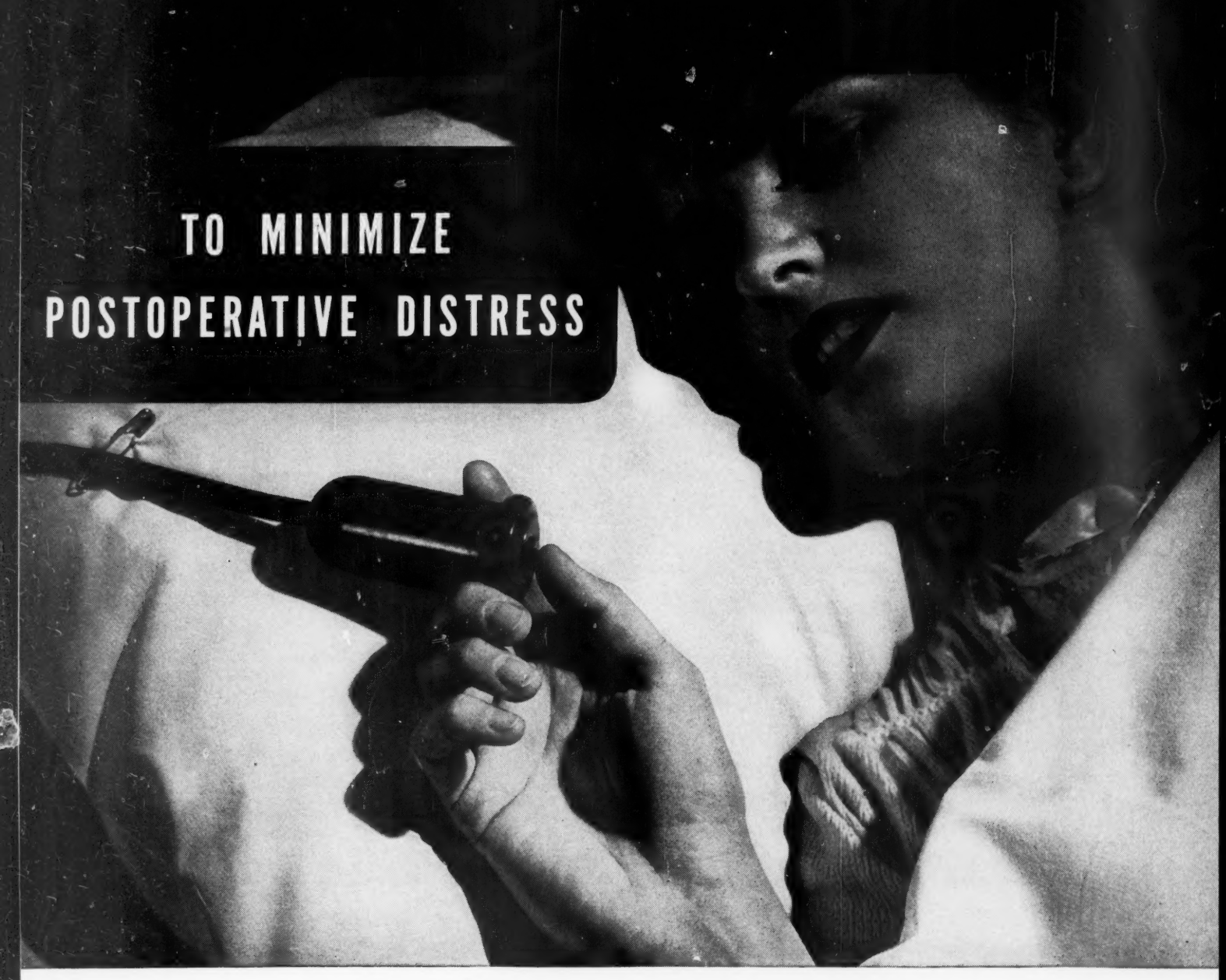

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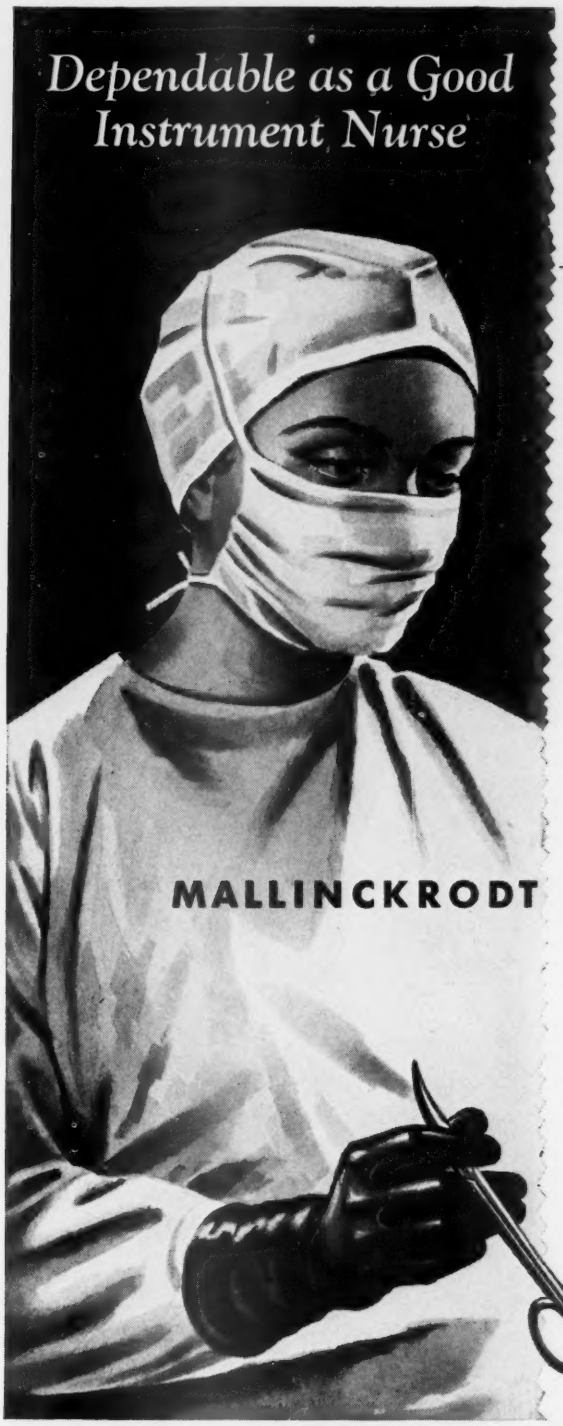

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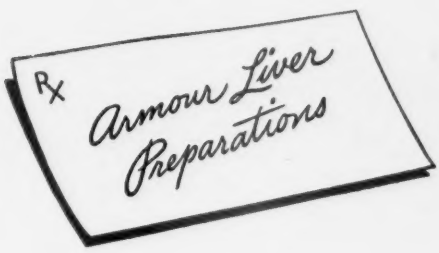

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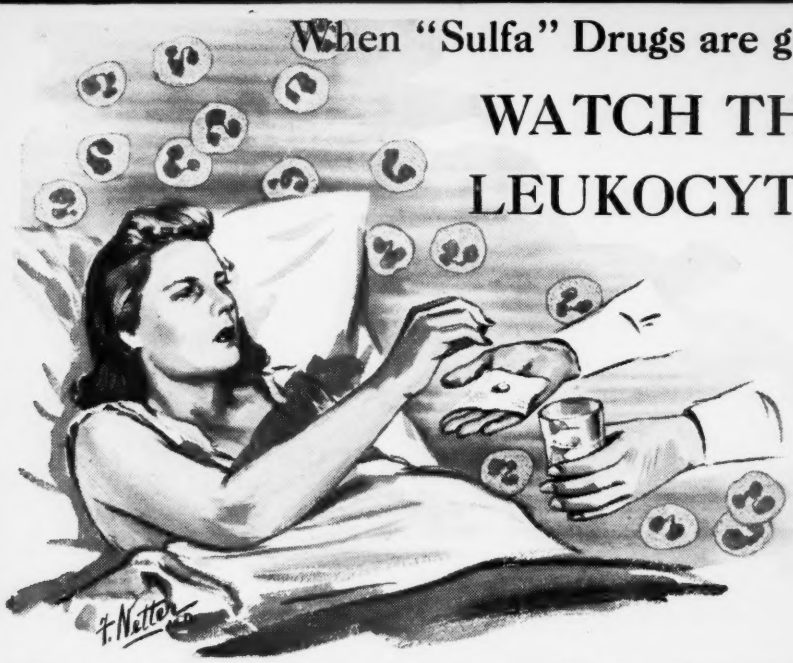

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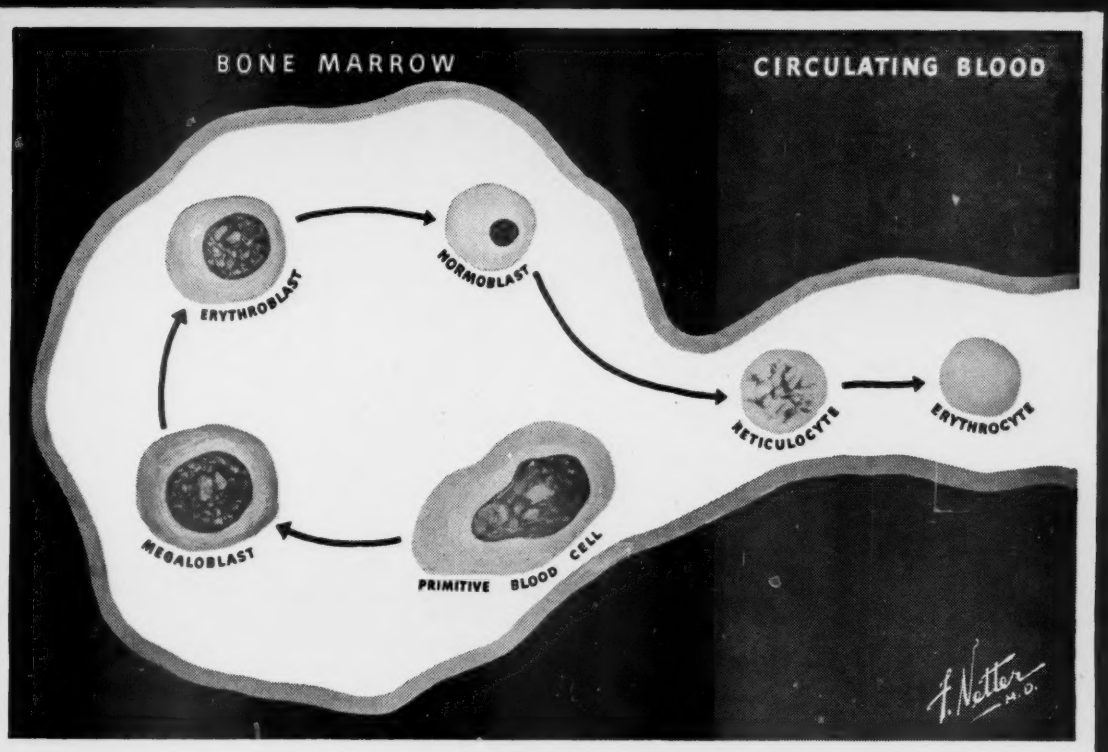

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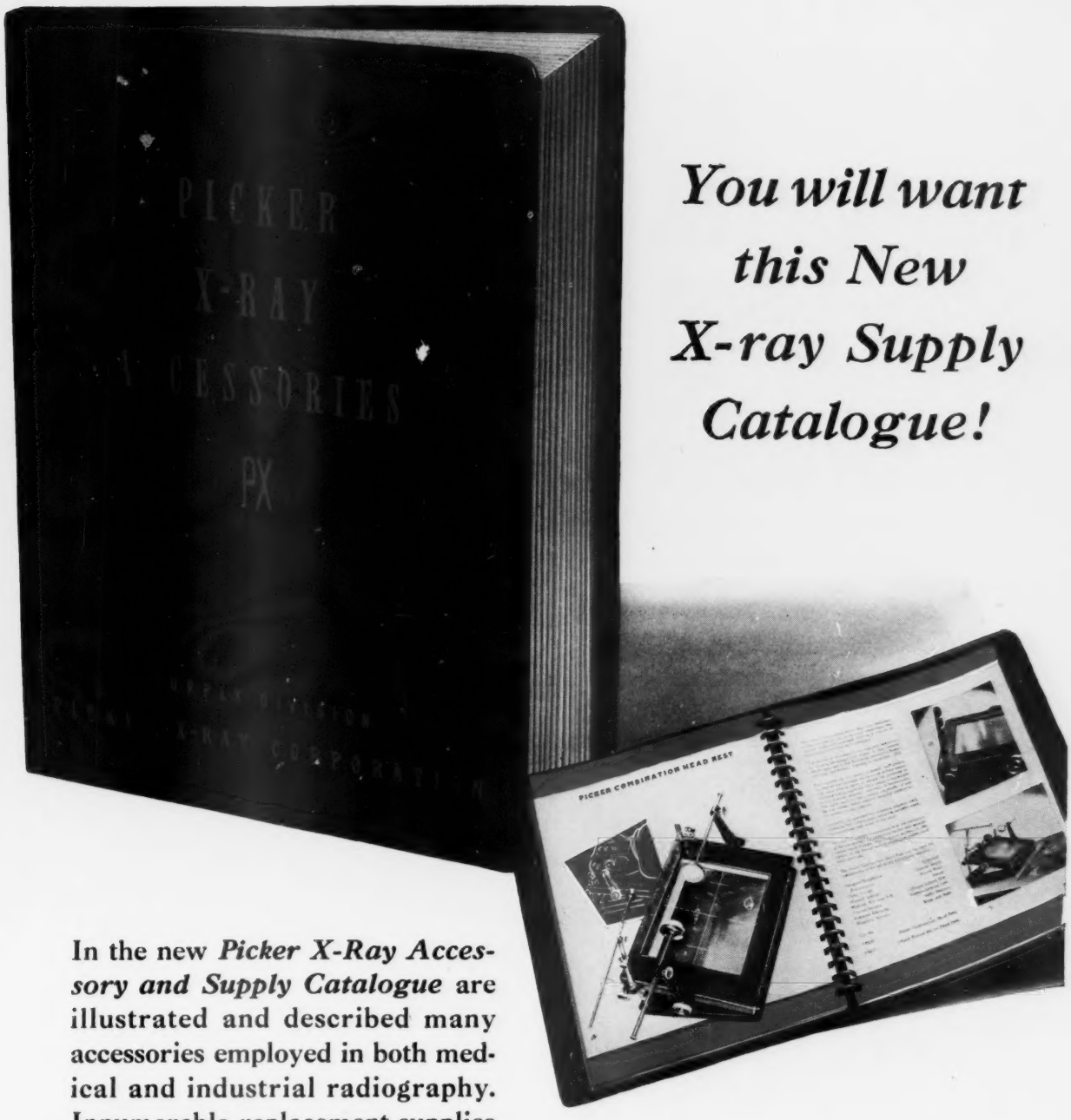

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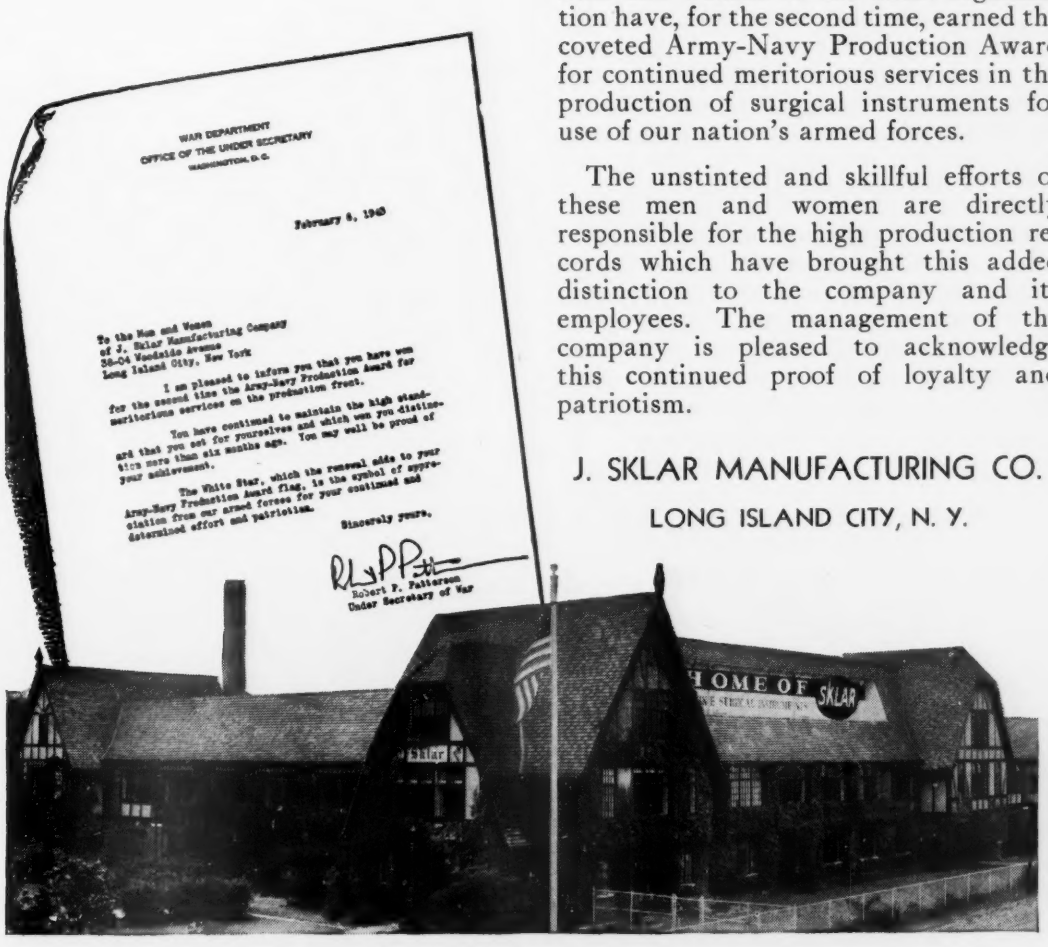

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February 6, 1943

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Sincerely yours,

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Under Secretary of War

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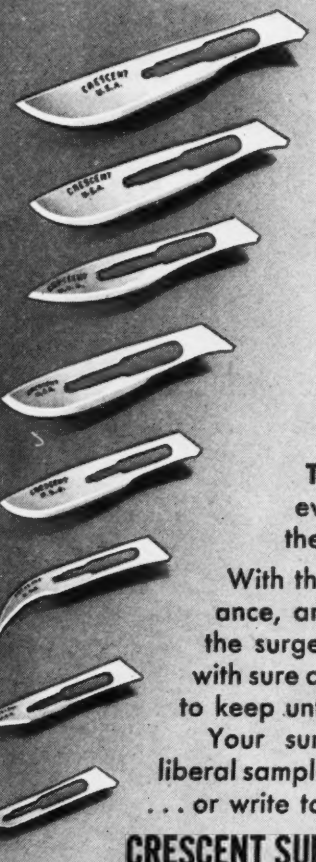

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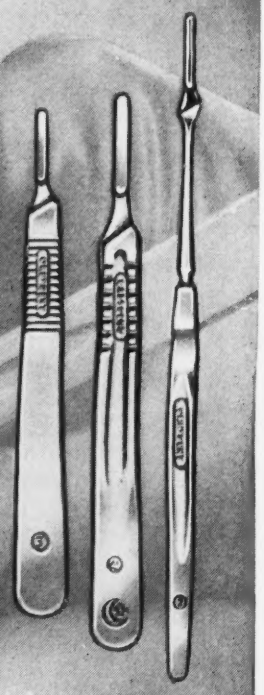

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1. Hand of 54-year-old male, revealing second degree burns sustained in oil burner explosion.

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From this statement—and from those of other leaders in the field of anesthesia—it may be concluded that ether is probably the world's safest—most adaptable—most widely used anesthetic agent.

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Squibb Ether is used in over 85% of American hospitals—in millions of cases every year. Such widespread use is evidence of the confidence which surgeons and anesthetists have in the ability of Squibb Ether to produce safe, satisfactory anesthesia.

[1]Romberger, Floyd, T.: *J. Indiana S. M. A.* 35:613 (Nov.) 1942.

For literature address Anesthetic Division, E. R. Squibb & Sons, 745 Fifth Ave., N. Y.

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A Table of Valuable Points for Allantomide*

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THE PRODUCT WITH 10 POINTS	FOR THE TREATMENT OF INFECTIONS, WOUNDS, BURNS AND ULCERS
POINT 1	Helps control and prevent infection or reinfection in wounds; useful in First Aid.
POINT 2	Penetrates readily to infected area where the bacteria can be inhibited by the sulfanilamide.
POINT 3	Allantoin chemically debrides necrotic tissue.
POINT 4	Allantoin stimulates cell growth.
POINT 5	Ease of application eliminates damage to delicate tissue.
POINT 6	Absence of caking obviates the need of frequent redressing.
POINT 7	Alleviates pain by exclusion of air from denuded surfaces, and decreases loss of body fluids.
POINT 8	Provides a semi-fluid covering over wound or burn, allowing uninhibited motion.
POINT 9	Rapid rate of healing minimizes scars and contractures.
POINT 10	An elegant pharmaceutical compatible with the body fluids; no staining of tissues or clothing.

*Reg. U.S. Pat. Off.

● Allantomide* is a combination of allantoin 2% with sulfanilamide 10% in a greaseless, hydrophilic base. It combines the latest scientific knowledge for the control of infection and stimulation of tissue growth. Available in one ounce, four ounce, one and five pound jars. Write The National Drug Company, Dept. B, Philadelphia, Pa. for information and a clinical sample.

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WHAT SURFACE TENSION MEANS TO A GERMICIDE

An antiseptic with high surface tension does not enter skin crevices freely; therefore, its anti-bacterial action is limited to those organisms which are in readily accessible places.

The low surface tension of Ceepryn, however, enables it to flow freely into minute hiding places of bacterial organisms.

Another advantage of the low surface tension of Ceepryn is the ability of the antiseptic to penetrate readily the wall of the bacterial cell, which greatly steps up its germicidal action.

Moreover, the powerful detergent action of Ceepryn is valuable for its cleansing effect during antisepsis, and its ability to loosen and remove dead tissue cells.

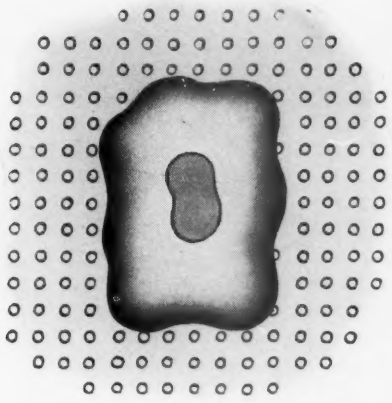
CEEPRYN

Brand of Cetylpyridinium Chloride

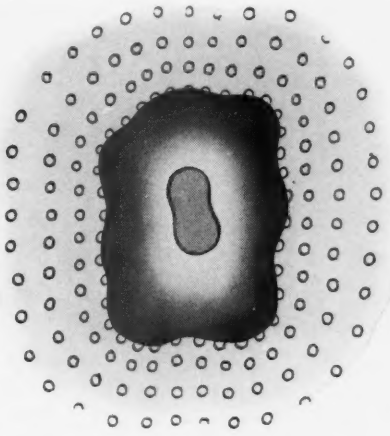
DIVERSIFIED ANTISEPTIC RANGE OF CEEPRYN

Ceepryn is non-selective in its range of antiseptic activity. It is powerfully destructive to a very large number of species of bacteria and fungi.

Trade Mark "Ceepryn" Reg. U. S. Pat. Off.



Germicide which does not lower surface tension is slower to diffuse through cell wall. Molecules of germicide are distributed uniformly throughout the solution.



Ceepryn lowers surface tension, therefore diffuses through cell wall quicker. Molecules become concentrated about cell wall through adsorption, giving greater germicidal action.

CEEPRYN IS SAFE TO USE

Clinical and pharmacological studies have demonstrated the safety of Ceepryn and its lack of tissue toxicity. It permits normal healing while preventing and controlling infection.

Ceepryn is offered in three forms, all reasonably priced:

Ceepryn Aqueous Solution 1:1000
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Ceepryn Tincture 1:200
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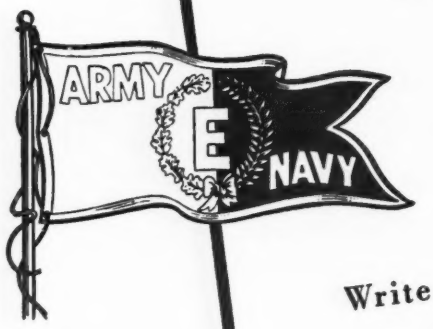

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TECHNIC OF LIPIODOL INSTILLATION

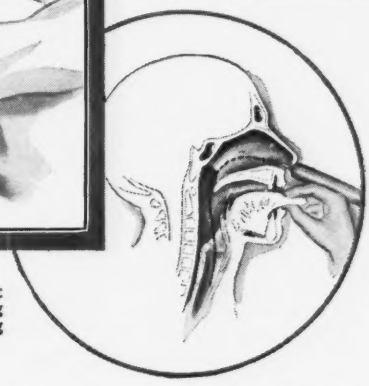
BRONCHOGRAPHY

Method of Forestier

In the visualization of the bronchial tree, the pernasal method described by Forestier* in 1934 possesses several advantages. No special instruments are required; the patient is subjected to a minimum of discomfort; the technic is easily carried out. The tongue is pulled forward, thus closing the upper end of the esophagus. A topical anesthetic solution is instilled into one nostril with the head tilted back at an angle of 45°. The solution finds its way through the open glottis into the trachea and bronchi. The warmed Lipiodol is instilled after five minutes, and the position of the patient is adjusted according to the portion of the bronchial tree which is to be visualized. With Lipiodol (iodized poppyseed oil containing 40 per cent iodine in chemical combination), brilliant roentgenograms of the bronchial tree ramifications are produced, affording a valuable aid in diagnosis.

Wrong method; fluid entering esophagus when tongue is not pulled forward.

Correct method; the path followed by fluid when tongue is pulled forward.



The head in correct position, showing method of instilling fluid into nostril.

The complete description of the method of Forestier* in bronchography, as well as the many other valuable applications of Lipiodolography, are graphically presented in a new brochure "The Applicability of Lipiodol in Roentgenography and the Technic of its Use." Physicians are invited to send for a complimentary copy.

*Forestier, J., and Leroux, L.: Simplified Method of Bronchography, Radiology *24*:743-744 (June) 1935.

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(STABILIZED SULFATHIAZOLE-DESOXYEPHEDRINE SOLUTION, ABBOTT)

Antiseptic and Germicide with a New Chemical Structure

ZEPHIRAN CHLORIDE is a mixture of high molecular alkyl-dimethyl-benzyl-ammonium chlorides, and represents a new concept of bacterial destruction on the basis of a cationic detergent.

Welch and Brewer* state that the protective action of the blood plays an important role in infection, and the indiscriminate application of antiseptics which destroy this function at dilutions which cannot destroy bacteria is a harmful practice.

Though a very potent germicide and according to their studies capable of destroying Staphylococcus aureus in a concentration of 1:6,250 in 10% serum, they found ZEPHIRAN CHLORIDE non-injurious to the delicate phagocytic mechanism of the white blood cell in concentrations up to 1:3,000. Expressed in terms of the toxicity index, ZEPHIRAN CHLORIDE was rated as 0.48 whereas alcohol was shown to have a toxicity index as high as 7.5.

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- DETERGENT PROPERTIES
- A WETTING AGENT
- HIGH TISSUE TOLERANCE
- PENETRATION ABILITY
- RAPID ACTION
- EMOLLIENT EFFECT
- WIDE APPLICATION
- ECONOMY

Zephiran CHLORIDE . . . Germicide for Surgery, Obstetrics and Gynecology, Urology, Dermatology, Eye, Ear, Nose and Throat, Sterile Storage of Instruments

*Welch, H., and Brewer, C. M.,: The Toxicity-Indices of Some Basic Antiseptic Substances, Jl. of Immunology, Jan., 1942.

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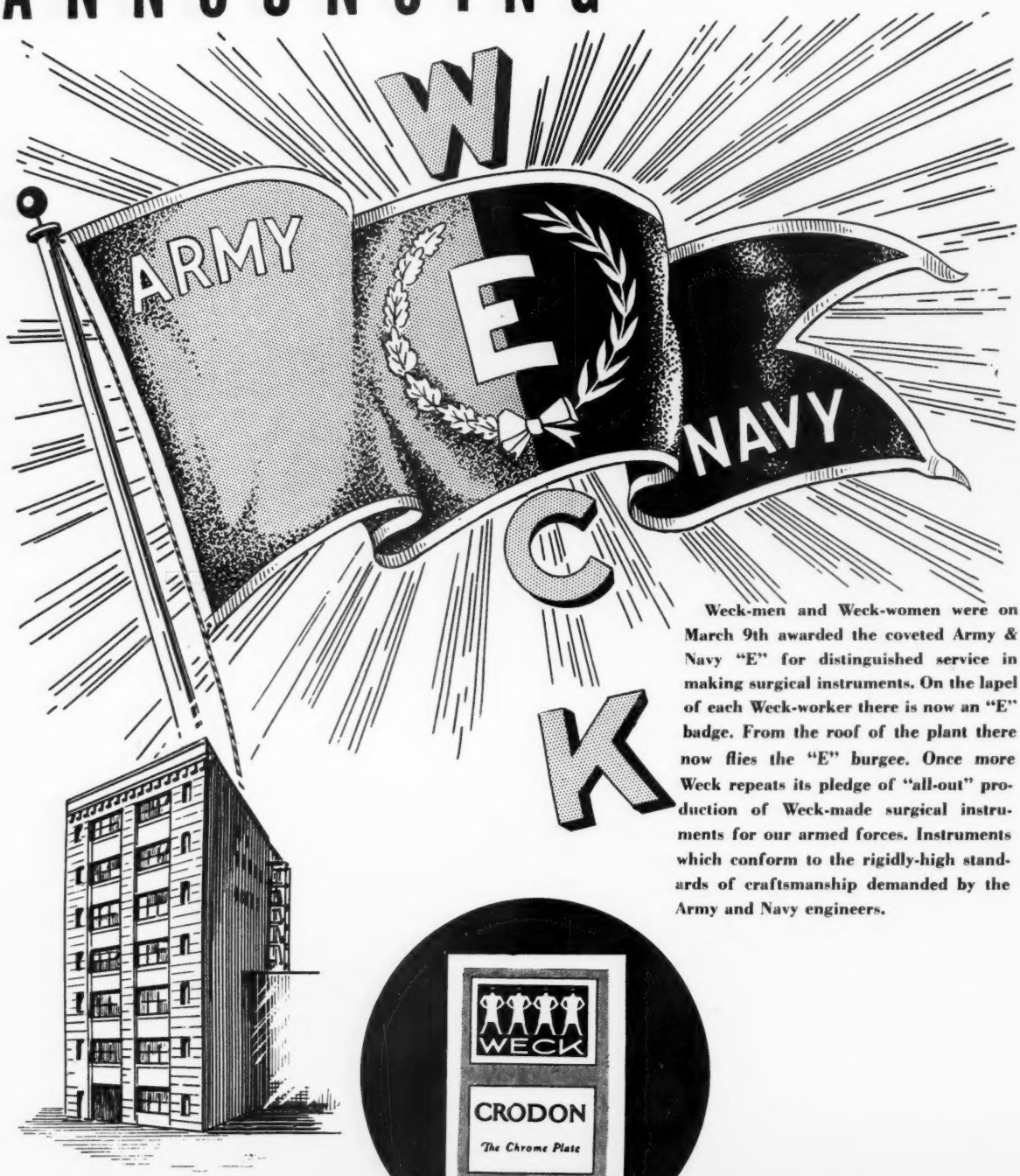

Weck-men and Weck-women were on March 9th awarded the coveted Army & Navy "E" for distinguished service in making surgical instruments. On the lapel of each Weck-worker there is now an "E" badge. From the roof of the plant there now flies the "E" burgee. Once more Weck repeats its pledge of "all-out" production of Weck-made surgical instruments for our armed forces. Instruments which conform to the rigidly-high standards of craftsmanship demanded by the Army and Navy engineers.

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A PRACTICAL JOURNAL BUILT ON MERIT

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NEW SERIES VOL. LX APRIL, 1943 NUMBER ONE

Editorials

ABDOMINAL SURGERY

TWENTY years ago an eminent professor of orthopedic surgery was wont to say that it was difficult to interest medical students in bones and joints as their interest was completely absorbed by and lost in the abdomen. Though that statement was true twenty years ago, it is not true today. While many of our better trained recent graduates are going into neurosurgery, orthopedic surgery, thoracic surgery, traumatic surgery, and other surgical specialties, seldom does one limit his work to abdominal surgery.

No longer should abdominal surgery be the step-child of that impossible-to-define parent known as general surgery. It is impossible to define accurately as no one properly trained attempts to practice it. In the eyes of the public a general surgeon is anyone who answers all calls, treats sprains, reduces fractures, attends automobile accidents, sutures wounds, removes appendices and tonsils, delivers babies, attempts to repair hernias, lances boils, and does anything else a liberal legislature and tolerant public will permit.

Something of that attitude is being displayed by hospital staffs, teachers and administrators. Young physicians with insufficient training and supervision are permitted to remove appendices, attempt herniorrhaphies and uterine suspensions, and other intra-abdominal operations although it would be unthinkable for them to treat a club foot or pass a cystoscope. The idea persists, wholly false though it is, that abdominal surgery is easier to master than some of the other surgical specialties.

The accumulated knowledge of intra-abdominal conditions is now so vast that the time is at hand for young surgeons to go into abdominal surgery as a separate, well-defined specialty. It is difficult to find in this country many abdominal surgeons with the detailed knowledge of the abdomen which neuro-surgeons, thoracic surgeons and other specialists possess of their respective fields.

It is not enough that abdominal surgeons be versed in the gross anatomy and gross pathology of the abdomen, skilled in physical diagnosis and operative technic, and meticulous in pre- and postoperative care. They should know many other things in addition. They should know the indications, limitations and technic of gastroscopy and peritoneoscopy. They should understand what is known about the normal and disturbed physiology of the pancreas, liver, stomach and intestines. They should study blood dsycrasias as related to splenic disturbances. They should be able to consult intelligently with the roentgenologist upon the *x*-ray diagnosis of gastrointestinal and other intra-abdominal disorders.

Two few roentgenologists are competent in gastrointestinal diagnoses. For his

patient's welfare the abdominal surgeon should know as much as possible about it. He should also study the abnormal embryological development of abdominal structures as revealed in congenital defects requiring surgical treatment. He should be able to prescribe intelligently and in detail both pre- and postoperative diets. He should understand, as well as present knowledge permits, the manifestations of gastrointestinal allergy.

Should the young surgeon's time and attention be directed as suggested above, he will have little time for anything else. Both he and his patients will profit thereby.

Malcom Thompson, M.D.

POSTOPERATIVE USE OF SULFONAMIDES

In the repair of cleft lips and in the repair of lacerations of the skin of the face which require minute approximation, it has been found that the local use of sulfonamide powder in the wound forms a very adherent mixture which obliterates completely, or makes exceedingly difficult, the definition of the skin margins. For this reason the local use of such sulfonamide powder has been discontinued and the policy of the oral administration of the appropriate sulfonamide in adequate dosage postoperatively has been adopted. This has resulted in extremely clean wounds and rapid healing, with an absolute minimum of scarring. It is found that the inflammatory area which usually surrounds a retained skin suture is notably absent.

It is the author's wish, therefore, to recommend this procedure to those who are doing the fine type of repair which requires absolutely precise approximation of skin edges and ability to recognize such skin landmarks as the vermilion border of the lips.

George C. Foster, M.D.

Original Articles

FOREIGN BODY LOCALIZATION AND EXTRACTION

DESCRIPTION OF A METHOD MORE ACCURATE THAN THAT USED BY THE ARMY

LEWIS GREGORY COLE, M.D.
Diplomate of the American Board of Radiology; Roentgenologist to Hudson City Hospital, Hudson, New York
WHITE PLAINS, NEW YORK

THE detection of a metallic foreign body in the human body is a very simple problem for the roentgenologist; its accurate localization is much more difficult, and the search for and extraction of such a foreign body is often a very perplexing problem for the surgeon. A needle in the palm of a hand as seen in the *x*-ray film looks simple to remove but, like the Army "buck," it is usually passed from the chief surgeon to his assistant, then to the junior surgeon, and so on down the line, because its removal is without glory if successful, and with a razzing if not. The most notoriously evasive foreign body of recent times is a small fragment of steel in a man's arm that was recently reported and then quoted and requoted from coast to coast. Even though this fragment was only 1 cm. beneath the skin, two prolonged operations failed to remove it. I have seen these scars and stuck my fingers in them. This superficial foreign body was an ideal case for the magnetic method of localization and extraction, but the "diviner or detoner" did not even quiver when used to locate the foreign body deeply embedded in the identical wax model which is the theme of this communication.

The subject of localization was given very little civilian attention in time of peace, but the Army did consider it then and prepared for war by developing an Army *x*-ray field unit and localizing device.

With unlimited financial backing for experimental work this problem was undertaken with enthusiasm by the roentgenologic staff of the Army and a corps of Army engineers and draftsmen. In due time a field unit was developed and mass production was accomplished. This new field unit is very powerful, and is adaptable for base hospitals or for hospitals where transportation by truck or train is available.

The Army also designed an elaborate localizing device consisting of a sturdy horizontal table which embodies many principles of localizations developed in the last war, notably a convenient method of a very accurately shifting of a shock proof tube to facilitate fluoroscopic search for the foreign body and to determine its depth from a point on the surface. The depth of the foreign body may be read from a scale on the side of the apparatus. It has an ingenious gadget for marking one point on the surface of the body directly above the foreign body with indelible ink.

A phantom is provided with the equipment, so that the depth determining device can be readjusted on the field to assure its accuracy. This phantom has a flat base so that it rests firmly on the fluoroscopic table; its upper surface is also flat and parallel with the base. The marking device is such that a single point on the upper

surface of the phantom or human part is very accurately recorded.

It is planned by the Army to do only fluoroscopic examinations for the localization of foreign bodies, therefore, a large black tent having flaps provided with zippers rendering it lightproof and airtight, is part of the equipment.

A written report on special forms to insure uniformity, and an indelible mark on the upper surface of the part, is the manner in which the localizing data are transmitted to the surgeon. Roentgenograms on films or even on paper to show the surgeon the actual size, shape and relative position of the foreign body, are to be specifically avoided. No facilities for processing films or paper are provided. It is not the intention of the Army to have surgical extractions done in this *x*-ray tent.

FIG. 1. *Test Object:* Wax model containing a foreign body used to determine the accuracy of the Army method of localization compared with another method. The large hole to the left was made in an unsuccessful attempt to remove a foreign body by the Army method. The small hole to the right leads directly to the foreign body, located by another method. The white spot in the center of the small, diamond-shaped hole, is the foreign body. This photograph conveys no sense of depth of the holes, so Figures 2 through 5 are presented to give the depth and width of the two holes.

The Army is so proud of this field unit and localizing device that some of them were sent to Russia. It is a beautifully constructed apparatus, but there is just "one fly in this alabaster jar of ointment," namely, *it is not accurate for localizing bullets in the human body*. When this inaccuracy, or at least the inefficiency, of the Army apparatus for localizing foreign bodies in the body rather than in the flat base phantoms was recognized, it was suggested that a localization be done on a human body, preferably a leg, arm or head. However, as no such patient was available,

it was suggested that a wax model, similar in size and shape to the human thigh, be substituted for the Army's flat-based phantom, and that a foreign body embedded in this wax model be localized by the one who had designed the Army apparatus. This cylindrical wax model was so constructed that it has the same tendency to roll outward as does the human leg when the subject is lying on his back. This tendency was discussed and overcome by propping it into position when the localization was done.

In order to avoid any possible error, the localization was repeated on this wax model, and the accuracy of the original localization was confirmed. It was then suggested that the foreign body be extracted through as small a hole as was practical in order to establish the accuracy of this method of localization.

This extraction was undertaken with great enthusiasm by the one who had actually done the localization with the Army apparatus he had designed. A request was made that this procedure be reported to the National Council of Defense, where the subject was to be discussed in the near future. This request was gladly granted but it was considered reciprocal.

The enthusiasm waned as the procedure progressed and the foreign body was not encountered or extracted. A photograph of the wax model (Fig. 1) and a series of roentgenograms tell the rest of the story better than words. In this futile search for the foreign body a hole was made in the wax model large enough to admit three fingers, yet the foreign body was not found by the Army method of localization. The size and shape of this hole are more accurately recorded by the full-sized reproductions of roentgenograms of the wax model made in two directions after the hole had been filled with a barium mixture. (Figs. 2 and 3.) What if there had been a human thigh or head available for this localization, instead of a wax model? If this were the best that could be done by anyone using any method of localization, it would be unwise to reveal these facts, but this is not the case.

Immediately after this failure to extract the foreign body on the basis of the data determined by the Army method, the same model was employed to illustrate how readily the identical foreign body could be extracted when undertaken on data obtained by another method of localization.

A small diamond-shaped incision was made in the adhesive tape surrounding the wax model, and through this small incision, following the line indicated by a specially constructed apparatus, the one who had failed to extract the foreign body by the Army method and who had never seen this instrument before, used it according to instructions, rapidly evacuated the wax, and hit the foreign body "square on the nose." This was accomplished through a conical hole that was not nearly as large as one's little finger, as shown in Figures 2 and 3. This small conical hole was immediately adjacent to the large hole which had been previously made in the unsuccessful attempt. The small size and shape of this conical hole, indicating the accuracy of this method, is shown even more vividly by full-sized reproductions of roentgenograms (Figs. 4 and 5) than by the photograph of the wax model. (Fig. 1.)

Critics might justly say that the Army method is all right for flat bottomed phantoms and that this method may be all right for wax models, even though they are cylindrical, but what evidence is there that it will work on human beings? The following case, referred by a surgeon who said, "This is a hard nut to crack," is the answer to that question:

A colored woman, weighing nearly 200 pounds, felt a sharp pain in her shoulder as she threw a rug over it. She then threw the rug to the floor, and picked a fragment of needle from her shoulder. A roentgenogram made at the City Hospital revealed two small fragments of a fine needle located high up in the axilla, just below the lower lip of the head of the humerus and about halfway between the

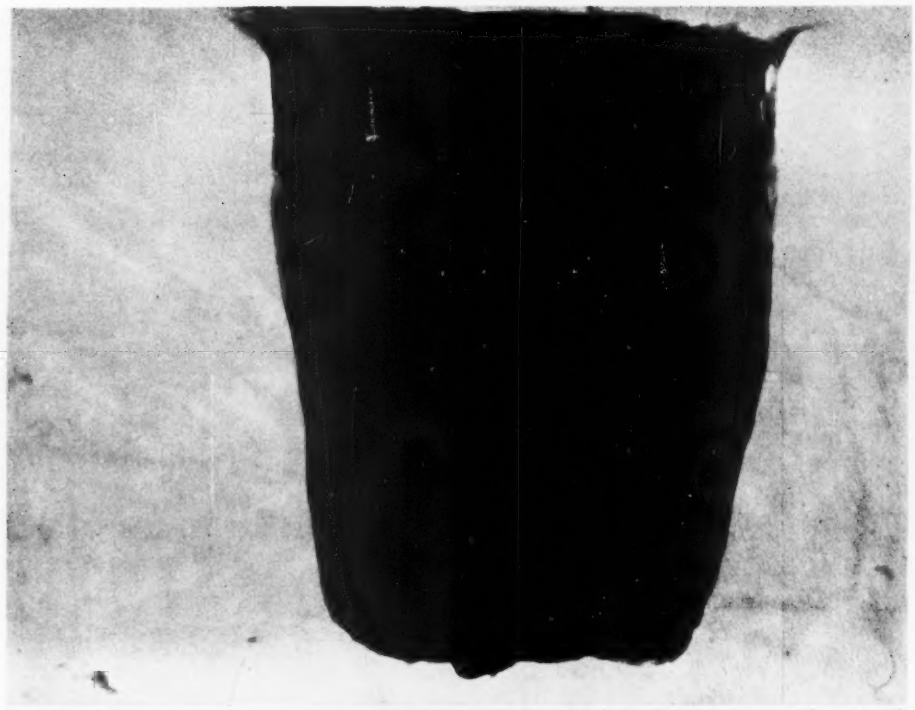


FIG. 2.

FIG. 3.

FIGS. 2 AND 3. *Unsuccessful Approach:* Full sized reproductions of roentgenograms in two directions show the Army hole filled with barium paste. These two roentgenograms accurately indicate the mutilation of the model in the unsuccessful attempt at extraction. Compare with Figures 4 and 5.

FIG. 4.

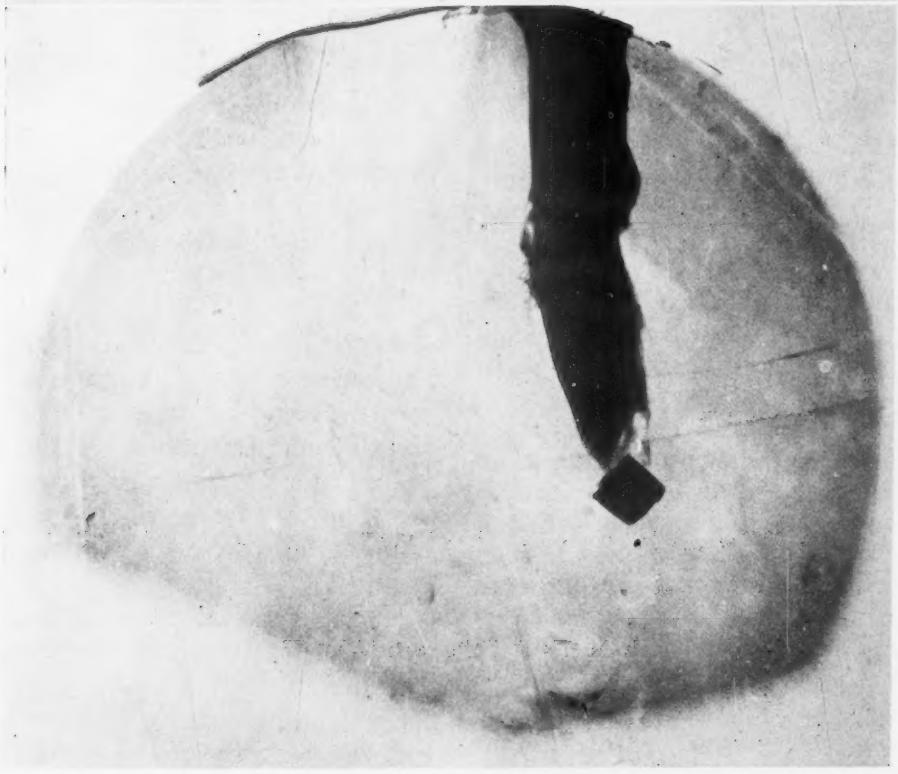


FIG. 5.

FIGS. 4 AND 5. *Successful Approach:* Full sized reproductions of roentgenograms in two directions show a small conical hole leading directly to the foreign body. This hole indicates the minimal amount of mutilation caused by the successful extraction.

anterior and posterior surfaces of a relatively large shoulder. The localization was accomplished with the aid of instruments which were

Fig. 6. *Sighting Device:* Roentgenogram shows two small fragments of a needle located deep in the human shoulder, one is directly in the center of a sighting device; this one was extracted within forty-seven seconds.

so small as to be carried in one's pocket. They were adapted to an old horizontal fluoroscope and the localization was undertaken under most adverse conditions, with a gallery of doctors waiting to see it fail. Figure 6 shows the two fragments of the needle as they come within the field of the localizing apparatus.

The patient was transferred from the fluoroscopic table to the operating table; the companion surgical instrument was adjusted according to instructions, based on the roentgenologic localization data, and the specific fragment which is in the center of the localizing device (Fig. 6) was removed in forty-seven seconds. The other fragment, slightly off to the side of the field, was not specifically localized and it required nearly twenty minutes to find it, even though the surgeon was searching within its immediate vicinity.

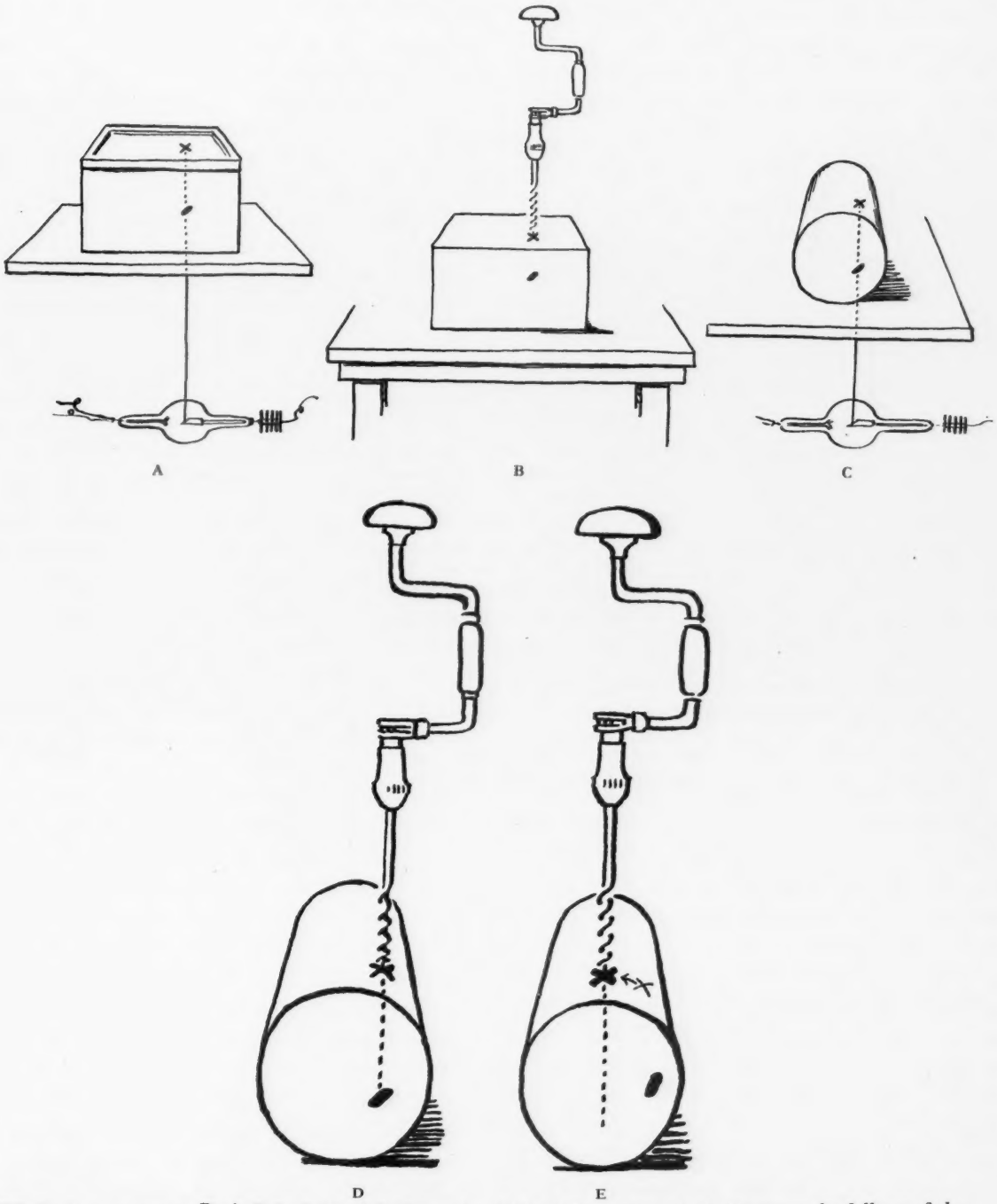
Even this might be considered "happen stance" if it were not for the fact that this method of localization employed a basic principle that was not employed in the Army method. The principles underlying these two methods might be termed the "one-point method" as employed by the Army, in contradistinction to the "two-point method" by which the foreign body in the cylindrical wax model and the needle in the human shoulder were accurately located. The basic principles employed in these two methods can be more readily conveyed to the reader by drawings than by wordy descriptions. The basic principles of the one point method is shown in Figures 7A, B, C, D and E.

A wooden block contains a foreign body that is deeply situated in it, but it is nearer one end than the other. By fluoroscopic examination, with the tube underneath the square block and the fluoroscopic screen above it, a point on the upper surface, directly above the foreign body, can be accurately determined and marked with an "X" by the Army method. (Fig. 7A.)

If the same block were set on a firm table, a good carpenter could bore a vertical hole directly at the point indicated by the cross (X) and hit the foreign body nine times out of ten; the only time he would miss would be if he tilted his bit one way or the other. (Fig. 7B.)

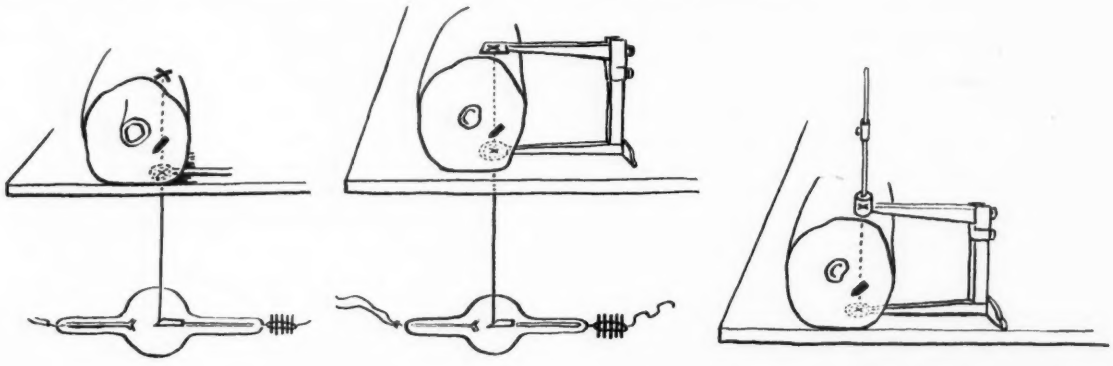
A foreign body eccentrically embedded in a cylindrical block, like the limb of a tree, likewise could be detected by fluoroscopic examination and its location indicated by an "X" on the upper surface of the block, the same as it was on the square block. This could be done with the Army method. (Fig. 7C.)

If this localization were done by a roentgenologic architect with the statement that the foreign body was 3¾ inches directly beneath a single mark, "X," on the surface, and the wooden cylinder then sent to a carpenter with specifications to bore a hole 3¾ inches deep directly beneath this "X" with no specific instructions as to positioning the block when he bored the hole, the carpenter would not place the block "off center" as shown in Figure 7D, in the same position as it was when the localization was



FIGS. 7A, B, C, D AND E. *Basic Principles of the One-point Method:* Drawings which illustrate the fallacy of the one-point method of localization used by the Army. "X" on the upper surface of the block. B, if the square block sat firmly on the table a carpenter could bore a hole straight down and hit the foreign body nine times out of ten. C, a foreign body embedded off center in one end of a cylindrical block could likewise be located by *x*-ray and its position indicated by an "X" on the upper surface of the block. D, a carpenter instructed to bore directly down would find it difficult to do so because the block would roll, and so unless instructed otherwise would roll it on center, as shown in E. E, thus with the "X" on center, if he bored directly down, he would miss the foreign body by a finger's breadth; thus the fallacy of the one-point method.

done, first because he would not know what that position was, and secondly because with the "X" off center, it would tend to roll as he put pressure on the bit. Therefore, if not instructed otherwise, he would roll the block "on center," as shown in Figure 7E, and then bore straight down, because it would be more convenient for him to bore a hole with the block in that position, and in doing so he would miss the foreign body by a finger's breadth or more. So would the surgeon working on a leg put the leg in the most convenient position for his surgical approach, unless instructed otherwise. He would flex the knee slightly, rotate the leg outward, and like the carpenter with the bit, he would miss the bullet by the same distance as the carpenter would have missed it in the wooden cylinder. The Army officer did miss it in the wax model where this identical principle was involved. When only a single mark on the surface is used as a guide, this same source of error is present in all extremities and in irregularly spherical parts, such as the head which can be rotated in four directions instead of two or any combination of the four. In these instances the problem becomes immensely more complicated.



A B C

FIGS. 8A, B AND C. *Basic Principles of Two-point Method:* Drawings that illustrate the accuracy of the two point method rejected by the Army. A, a foreign body embedded deep in a cylindrical block, a wax cylinder or a human leg, can be detected and its location indicated by one mark "X" on its upper surface and another on the under surface. The upper mark is readily made by any method, including the Army. The lower mark "X" is established by a ring marker that is moved about beneath the part until its image on the screen encircles the foreign body. Thus the foreign body is directly in line between the upper and lower marks "X." B, *roentgenologic caliper:* A convenient device or caliper for making the upper and lower marks at one time. By fluoroscopy or on a film one sees the ring marker, foreign body and square with the cross wires all in line, as shown in Figure 6. C, *surgical caliper:* A surgical instrument that is the counterpart of the *x*-ray caliper, is so designed that the distal end of the lower arm is attached to the skin at the lower mark "X" and then the part is adjusted so that the pointer at the distal end of the upper arm rests on the "X" on the upper surface. A knitting-needle-like pointer in the upper arm points directly to the lower mark and thus to the bullet and guides the surgeon to the foreign body. A stop on the pointer indicates the depth previously determined by a double shift of the tube, using any one of several mathematical formulas, or a sliding square to eliminate computation.

The basic principle of the two-point method is shown in Figures 8A, B, and C. With the two-point method, two marks (two "X's") are made on the cylindrical block of wood or on the cylindrical wax model, or on the human part. (Fig. 8A.) One of these marks is on the upper surface and the other is on the undersurface, each in line with the foreign body, as observed fluoroscopically with the tube beneath the table. The mark on the upper surface would be recorded in exactly the same manner that it is the one-point method, but in addition to this if a ring pointer were placed beneath the part and moved into such a position that the shadow cast by it on the fluoroscopic screen perfectly encircles the image of the foreign body, and another mark were placed on the under surface of this part directly where the ring pointer was located, the two-point method of localization would be established. A line drawn through these two

points would transect the foreign body. (Fig. 8A.)

An *x*-ray caliper (Fig. 8B) has been designed and constructed to facilitate making both of these marks, one on the under surface and the other on the upper surface. The accuracy with which the roentgenologist does this is recorded on a small roentgenogram made either on film or on paper. Such a roentgenogram is shown in Figure 6 in which the two fragments of a needle are seen within the same field.

A companion surgical caliper (Fig. 8C) is so constructed that when it is adapted to the part by the surgeon, the part can be repositioned in exactly the same position that it was at the time the localization was done by the roentgenologist. This is accomplished by fixing the distal end of the lower arm of the surgical caliper on the under marker and repositioning the leg or part so that the distal end of the upper arm of the caliper rests exactly on the upper mark. Therefore, the foreign body must be in a direct line between the end of the upper arm and the end of the lower arm of the surgical caliper. In the upper arm of this caliper there is a knitting-needle-like pointer that acts as a guide to direct the surgeon toward the foreign body. Furthermore, there is a stop on the pointer which indicates the exact depth of the foreign body beneath the surface.

This surgical caliper was the instrument used by the Army officer in his successful search for the foreign body in the wax model and was also used by the surgeon in his successful search for the small fragment of needle in the shoulder.

A tabulated comparison of the new Army *x*-ray field unit and localizing device, and the one herein suggested is as follows:

One-point Army Method

1. Valuable only as a complete unit.
2. Localizing device and necessary equipment weigh approximately 1000 pounds.
3. The *x*-ray unit and localizing apparatus weigh more than a ton (estimated).
4. Can be shipped only by boat, train or truck.
5. Fluoroscopic examination only.
6. Can be used only in total darkness in lightproof and suffocating black tent.
7. Surgeon has only the roentgenologist's say-so in word description.
8. No mechanical device to guide surgeon.
9. Cost $4,000 (approximate).
10. Speed for examination said to be 20 per hour.
11. Used for all kinds of *x*-ray work but patient must be brought to apparatus.
12. Fluoroscopy only; surgeon must take roentgenologist's word.

Two-point Method

1. Usable on any horizontal fluoroscope.
2. Localizing apparatus and film processing equipment weight approximately 50 pounds.
3. The *x*-ray unit and localizing equipment weigh approximately 150 pounds.
4. Can be flown anywhere.
5. Both fluoroscopic and roentgenologic examinations.
6. Used in any moderately light place, in the open if necessary, where one does not beg for air.
7. Surgeon can see size and shape of foreign body for himself.
8. Very accurate guide for surgeon.
9. Cost $500 (estimate).
10. Speed same.
11. All kinds of diagnostic work, portable unit can be taken to patient without disturbing him.
12. Surgeon and roentgenologist can study roentgenograms together and segregate serious cases from simple ones.

If all these facts concerning the accuracy of the two-point method, its adaptibility to any apparatus that may be available, its portability, low cost and its convenience be true, one would expect the Army to welcome this device as a solution to their perplexing problem of foreign body localization and extraction, especially in inaccessible places, but this is not the case.

Advice concerning the localization and extraction of foreign bodies could have been obtained by the Army from any one of scores of experienced roentgenologists throughout the country who had been trained intensively in the underlying principles of foreign body localization at one or another of the ten schools that were established with the consent of the Surgeon General in the previous war. These schools gave special training in foreign body localization and other phases of military roentgenology. The instructors were the most experienced roentgenologists of their time. Furthermore, hundreds of these men

had months and even years of actual experience in applying the basic principles during active service overseas in the first World War. Their advice, particularly the advice of those who had been specially interested in the subject of foreign body localization during the previous war was not sought. One fortunate fact, however, is that there are so many of these men still available to do accurate localizations in these boys after they are discharged from the army still carrying their foreign bodies.

An accessory device to the Army localizing unit is a horizontal marker used as a substitute for the biplane fluoroscopy. This device simply marks a point on the lateral surface of the body, at the depth of the foreign body from the upper mark. This apparatus is intended especially for the torso. The procedure is a step in the right direction but only a short one, because it does not aid the surgeon in repositioning the patient, and it offers him no accurate mechanical device to guide him directly to the foreign body.

In order to co-operate with the Army and to put at their disposal the apparatus and what experience had been gained in developing it, a full set of instruments, including a set of roentgen calipers, sliding square scale for determining the depth of the foreign body, a set of surgical calipers for aiding the surgeon in adjusting the part and the body, and the knitting-needle-like pointer to guide him, wax models for testing the accuracy of this apparatus, and a full set of instructions were sent. These were to be used by the Army any way they saw fit, to test them out themselves or they were to have sent them to any one or any group of experts they desired. These instruments were sent on April 15, 1942, and returned June 21, 1942; but there was evidence that very little attention had been paid to them during this time.

It is not suggested to the Army that this two-point method should be adopted by them as a substitute for the method which they have specified. It is only suggested that the two methods should be set up side-by-side, at some place not in the Army school, and that all the data obtained by a series of competitive tests to show the accuracy of the two-point method compared with the one-point method should be recorded by a third party, and presented to a jury of totally unbiased civilians, not a court martial by Army officers, not even a trial by a jury of doctors, but a trial by a jury selected from a panel of good, hardheaded carpenters, plumbers, instrument makers with a few mothers who have boys at the front. They should be given the data and allowed to judge their value. For 150 years such a jury has been good enough to decide the question of life or death of thousands of persons; if it is good enough for that, such a jury is certainly qualified to make a recommendation to their Congressmen and Senators, especially if it is impossible to accomplish anything from within the Army—with thanks to Jim and Joe and others who have encouraged this revelation.

EARLY LAMINECTOMY FOR SPINAL CORD INJURY NOT DUE TO SUBLUXATION*

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FOR the past century, neurologists and neurosurgeons have debated the indications for laminectomy in spinal cord injuries, and opinion is still divided. War experience should clarify, perhaps decide this controversy. It seems, therefore, timely to review the present state of the problem and give our own impressions on the subject, illustrated by enough case histories to be instructive.

HISTORICAL REVIEW

About a hundred years ago, Sir Astley Cooper and Sir Charles Bell were debating the value of laminectomy in spinal cord injury. Since then, the pendulum of opinion has swung back and forth between conservative treatment or operative intervention in these cases. At the moment most neurosurgeons are not enthusiastic over laminectomy in spinal cord injuries; neurologists, on the other hand, have frequently believed that their overcautious attitude is, in many cases, not justified.

From the experimental standpoint, the only work we were able to find in the literature was that of Allen[1] (1908 to 1911) which, unfortunately, has not been given the attention we believe this valuable contribution merits. Allen produced spinal cord injuries in dogs by means of an instrument whereby a given weight could be dropped from a known height to produce a given impact. Laminectomy was first performed in the lower third of the thoracic region of anesthetized dogs. The instrument was then placed in position and the weight dropped on the cord. The resulting impact in Gram-centimeters was the product of the height in centimeters and the weight in Grams. As soon as an impact of 340 Gm/Cm was exceeded, spastic paraplegias were produced, which did not clear up spontaneously in the course of ten days as had the results of impacts of lesser severity. An impact of 450 Gm/Cm produced a picture of complete transverse lesion of the spinal cord resulting in the death of the animal in the asthenic-toxic state familiar to all with experience of severe spinal cord injuries in the human subject. In an attempt to determine whether this cessation of function was due to destruction of axis cylinders *directly* consequent to the impact, or *secondarily* following edema and hemorrhage into the cord tissue, which by its pressure and chemical activity resulted in ultimate cord degeneration, Allen made longitudinal section into the cord immediately after these injuries were produced. In the cases in which such incision was performed, the dogs made either a complete recovery or retained only slight awkwardness in the hind limbs, not enough to prevent running or jumping. Without operation, this impact would have resulted in the animal's death. From these experiments Allen believed that, in cases of fracture-dislocation of the spinal column in humans, in which

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there exists the symptom picture of transverse lesion of the spinal cord, "it were well to perform the operation of laminectomy at the earliest possible moment, and if the cord be not completely severed, to make a median longitudinal incision through the area of impact by means of a fine canaliculus knife in order to drain the injured tissue of the products of edema and hemorrhage." Unfortunately, we do not know any comprehensive series of cases in the human in which this radical procedure has been thoroughly tested.

Alfred Taylor[2] advocated laminectomy in cases of fracture by direct violence, noting that such injuries usually involved the spinous processes and laminae. In such injuries, the bodies of the vertebrae remain intact; the cord damage results from direct impact of displaced bone fragments, as well as from resultant hemorrhage. In fractures produced by indirect violence, he admitted that it is impossible to determine at the start whether or not a permanent complete transverse lesion of the cord has occurred. Many "apparently transverse lesions show spontaneous improvement after weeks or months," and he advocated theoretically "a generous laminectomy, wide splitting of the dura and incision of the posterior columns of the cord for relief of hemorrhage and edema." Again, we are not aware of his use of this procedure in any series of cases.

Frazier[3] was a strong advocate of surgical intervention in these cases of cord injury. Summarizing all statistics hitherto collected by various surgeons, a total of over seven hundred cases, he noted that "it is evident that, while the mortality is high both with or without operation, the percentage of recoveries or improvement is higher in the operated, than in the non-operated series." He admitted that these statistics were not to be accepted as decisive, pointing out that the cases upon which the late operation was performed, were those which had survived the immediate effects of the injury, and that they therefore, were a more favorable group for operative intervention. Furthermore, he believed that the risk of early or immediate operation had been overestimated, and reported his own experience of twenty early operations with but one fatality. This solitary misfortune occurred in a fracture of the fifth cervical vertebra, "the patient succumbing on the fifth day, not because of the operation, but from involvement of the phrenic center." He was emphatic in pointing out that improvement in neurosurgical technic had been so great that one could reasonably expect a striking reduction in mortality rate. Prior to 1911, the operative mortality associated with laminectomy was 20 per cent, whereas from 1911 to 1915 it was less than 7 per cent. Most neurosurgeons will agree that today the operative hazard has been even more greatly lowered. Lastly, Frazier mentioned cases in his own clinical experience in which function had been recovered after operation, which, without operation, could not have been expected.

This old quarrel over the indications for laminectomy in spinal cord injuries was reviewed in a symposium of the Royal Society of Medicine in 1927. At this time, Jefferson,[4] took a pessimistic view as to the value of laminectomy, believing that in most cases the cord is damaged by instant, irreparable, contusion and that too much was made of cord compression. To quote from Jefferson, "I will not go so far as to say pressure never occurs; in rare instances, it can be traced in gradually increasing amount. Such cases cry aloud for operation, but are exceedingly uncommon." In a later paper[5] he again emphasized that in cord injuries, hematomyelia is rare, and that the cord swelling after trauma is more often due to "local neural disruption, to relatively bloodless contusion, rather than to intramedullary clot. The damage is in rupture of myelin sheaths, fracture of axones and nerve fibrils—and a distortion of the general cord pattern." Despite these severe underlying pathological alterations, Jefferson believed "the appearance of the cord in some fatalities leaves the impression

that the patient might have recovered if he could have survived the initial period of profound depression of function." He states he cannot recall a case in which complete motor and sensory loss was present, in which recovery occurred, but no mention is made as to the number of such patients he had operated upon with this purpose in mind.

Quoting the Medical Research Council study at this symposium, Riddoch,[6] gave the following summary of their conclusions: (1) The full extent of cord damage is immediate. (2) Extramedullary hemorrhage is not a cause of cord compression. (3) Indriven fragments of bone, pressing on the cord, are passive agents not vital, or growing like a tumor. Increasing disturbance of function as a result of their presence is only secondary, due to fibrosis or loculation of cerebrospinal fluid. Their immediate removal is not necessary. The Council stressed the danger of operation during the period of "spinal shock," especially in the cervical and upper thoracic regions. They believed laminectomy should not be undertaken earlier than two to six weeks, and that it was only justified then, if there were gross bony deformity accompanied by incomplete cord lesion, or arrest of recovery, or severe and persistent root pain.

We shall later give our reasons for disagreeing with this passive pessimism. We believe in more intervention and less appeasement.

Mutuel and Rousseaux[7] were strong advocates of early laminectomy, despite current conservative opinion. They believed that existing statistics could not establish the value of early laminectomy in cases of cord injury. All hitherto reported series of operated cases were open to criticism in that the statistics were old, were concerned with disparate facts, that the operative technic had improved and that, therefore, such material did not allow an opinion on the value of laminectomy. A similar point of view was expressed by Lériche,[8] who considers that "all fractures of the spine, at whatever level they may be, as soon as they are accompanied by neurological changes, ought to be immediately operated upon, without seeking to separate the phenomena of compression from destruction," because "if one knows how to do a laminectomy without useless trauma, without shock, under local anesthesia, it helps the patient and does no harm."

Lyerley,[9] summarizing the indications for laminectomy, pointed out that the neurological examination can only reveal the degree of physiological interruption, but not the extent of anatomical lesion. He believed that the important indication for operation was cord compression, best indicated by manometric block, and that penetrating wounds, even without block, require operation.

Despite these helpful recommendations, and despite the continuing progress in spinal surgery, the surgeons for a decade have become more and more timid and fearful in their attitude toward these cases. Papers opposing early operative intervention have been written by Grant[10] Lambrinudi,[11] Kleinberg,[12] Grinker,[13] Elsberg,[14a and b] Stookey,[15] Scarff,[16] Little,[17] Brain,[18a and b] Nielson,[19] Verbrugghen,[20] Stinchfield,[21] Taylor,[22] Wortis and Sharp[23] and Browder and Grimes.[24] The Surgical Cliveden Set! Most of them believe it is useless to operate upon a patient with a *complete* transverse lesion following injury, yet as we well know we have absolutely no method of clinically distinguishing a complete "physiological cord block" from a block caused by "transverse destruction." The conservatives, as would be expected, also deprecate operation during the period of "spinal shock"—a wholly indeterminable condition. We believe this attitude quite pusillanimous.

However, these people have not had it all their own way. Contrary views *have* been advanced. Mock,[25] McLean,[26] Oldberg,[27] Wechsler,[28] Love,[29] Voris,[30] Munro,[31] Coleman and Meredith,[32] Stuck,[33] and Clark[34] have all doubted the wisdom of this policy of "watchful waiting." Of particular inter-

est is the report by Stetten[35] of a case seen by one of us (F. K.) in 1933, in which laminectomy had to be urged upon the surgeon despite the apparently complete transverse character of the severe cord injury. The case had been looked upon as hopeless. On operation, however, despite normal *x*-ray findings, "both laminae of the sixth cervical vertebra were found fractured; there was a depression of the fractured arch and a curved spicule of bone, ¾ cm. long, was discovered pressing on the cord." Four months after operation, the once totally paralyzed patient was able to walk off the ward with only a slight spasticity of gait. Stetten quotes Foerster, of Breslau, as advocating operation in all cases as soon as shock has subsided. (Note well, here, Foerster refers to "general shock." His mind was far too clear to harbor such cloudy conceptions as "spinal shock.") As to his own attitude toward laminectomy, Stetten states: "As a matter of fact, there is really no alternative. The operation is an extremely simple procedure, without any element of seriousness, and can easily be performed under local anesthesia." We agree, and this paper is wholly to say why.

ILLUSTRATIVE CASES

Case I. J. L., aged fifty-four, an Italian laborer, admitted to the Bellevue Hospital Neurological Service on October 8, 1939, had fallen down a flight of stairs the previous afternoon, injuring his back. Immediately after the injury he noticed pain in the back of his neck, radiating down both arms. Twenty minutes later he felt uncomfortable sensations in his feet and lower legs and was put to bed at home. The paresthesias gradually spread up his legs and lower trunk and that afternoon urinary retention appeared.

All the limbs were weak, but the shoulder girdle muscles were of good power; the power in his hands was severely impaired. The legs were practically completely paralyzed. Deep reflexes were present in the arms, but diminished. The knee and ankle jerks were present on the right and could only be obtained on reinforcement on the left. The abdominal reflexes were absent. The plantars were equivocal bilaterally. All sensation was lost below cervical six. The patient was not in shock.

Lumbar puncture was immediately performed; the initial pressure was 90 mm. of water. There was a complete block of jugular compression and amyl nitrite. *X*-ray of the spine revealed a fracture of the articular process of the seventh cervical vertebra and backward displacement of the body of the seventh cervical vertebra.

Surgical consultation was obtained and it was the opinion of the surgeons that no operation be performed, but that the patient be kept in hyperextension. The next twenty-four hours revealed definite progression of this man's paralysis.

Lumbar puncture was repeated on October 10th; manometric block was again found. The patient was then seen by one of us (F. K.) who advised laminectomy.

Operation was performed by Dr. J. Lawrence Pool on October 10, 1939, and consisted of laminectomy and removal of the arches of the fourth to the seventh cervical; the dura was opened longitudinally with exposure of the spinal cord. "Spinal cord was large, fusiform and yellowish. A small amount of clotted blood was found at the site." The cord was decompressed and the usual closure performed.

Immediately after operation power began to return in the legs and sensation slowly improved. At the end of four weeks the patient was able to stand. The legs were slightly spastic. The knee and ankle jerks were brisk, the left being greater than the right. Some weakness still persisted in the right hand. A slight reduction of sensation was found below the seventh cervical segment. Further improvement was gradually noted. The patient was discharged December 4, 1939, walking very well with only slight spasticity and needing no support. There was still a slight amount of weakness in the right hand. Sensation had improved markedly with a slight amount of hypalgesia present below Thoracic 3 on the right and Thoracic 10 on the left.

Case II. F. K., a twenty-three year old tunnel worker, struck by a large boulder across his back on the morning of December 30, 1937, was immediately brought to Bellevue Hospital in shock. On examination he showed marked weakness in both legs, with hypalgesia and loss of sensation below Lumbar 2. The abdom-

inals were absent. The knee and ankle jerks could not be obtained. Vibration and position sense were lost in his legs. There was bladder and rectal incontinence and perianal sensation was also lost.

A lumbar puncture was performed. Spinal fluid was blood tinged. Complete manometric block was present. *X*-ray showed a comminuted compressed fracture of Lumbar 1, 2, 3, and 4 vertebrae. This was especially evident in the second lumbar vertebra which was completely split by the vertebra above it. There were also fractures of the seventh, eighth, ninth and tenth ribs on the right.

The patient rallied quickly from his initial shock, so that a laminectomy was performed by Dr. A. Kaplan that same day (December 30, 1937). The arches of the vertebrae Thoracic 12 to Lumbar 4 were exposed and the usual laminectomy performed. A good deal of liquefied blood infiltrating the superficial fascia was found dissecting the fascia away from the lumbar space. This blood did not clot. The fascia and muscles were stripped away subperiostially from Lumbar 1 to Lumbar 3 inclusive, revealing a fracture of the second lumbar spine. Laminectomy exposed the dura, which, at its lower border, was found to be definitely constricted by a shelf of bone. The spines and laminae of Lumbar 1 and Lumbar 3 were also removed and the cord began to pulsate freely. A fine catheter was then introduced in both directions extradurally and no obstruction was encountered. The wound was closed in the usual manner.

Gradual improvement occurred; the patient began to void spontaneously in one week and the abdominal reflexes returned in two weeks. Power in his legs slowly returned, and the patient was out of bed in March 1938, gradually walking about. He was discharged on August 30, 1938, with excellent power in his legs and only a slight sensory change persisting below Lumbar 1 and 2 on the right. At the time of discharge, he was voiding well and had good control of the rectal sphincters.

CASE III. G. B., a seventeen year old Porto Rican girl, while quarrelling with her lover, was shot in the chest five weeks before admission to Bellevue Hospital, July 28, 1941. The bullet had entered her left breast immediately paralyzing her from her hips down. There was complete loss of sensation below the hips and the patient was unable to urinate. There was complete rectal incontinence also. She was nursed expectantly for five weeks without improvement. The right leg was completely paralyzed, and motor power in the left leg much impaired.

Examination showed a flaccid paralysis of both legs, the right being more severely affected than the left. The patient was bedridden and could not stand without assistance. Knee and ankle jerks were absent. The lower abdominals could not be obtained and there was only a transient flicker of the left upper abdominal. No plantar responses were obtained. There was a complete loss of all forms of sensation below Thoracic 12 on the right; on the left sensation was markedly diminished to all forms below Thoracic 12, but not completely lost.

Lumbar puncture was done. The initial pressure was 65 mm. of water. There was an open manometric system. The total protein was 65 mg. Spinal fluid Wassermann and colloidal gold were negative. *X*-ray of the spine revealed a bullet still present over the right twelfth rib, ½ inch from the vertebral body. There was a slight abnormality of the right edge of the twelfth thoracic vertebra suggesting a possible fracture.

Laminectomy was performed on August 5, 1941. The eleventh and twelfth thoracic vertebrae and the first lumbar vertebra were exposed. A depressed fracture of the transverse process of the twelfth thoracic vertebra was found, extending into the articular facet. "This fracture undoubtedly caused some compression of the cord." The dura was opened and many adhesions found at the site of this fracture on the right. *A small spicule of bone was found imbedded into the right cord*, and this was removed. The cord and the spinal roots at the level of Thoracic 11 and 12 were found adherent to the dura and these adhesions were freed. The dura was closed and the wound repaired in the customary manner. There was an uneventful healing.

There was a slow, but slight improvement in the power of the left leg, but the patient continued paralyzed to a major degree. Bladder control improved, so that tidal drainage was no longer required and it could be evacuated easily by the Credé method. Lumbar puncture was repeated August 30, 1941, revealing normal fluid with no spinal fluid block. The patient was discharged October 13, 1941, as slightly improved.

Case iv. G. K., a twenty-one year old housewife, three months pregnant, while trying on a dress in a department store, tripped over a coat hanger and fell forward to the floor. She immediately noticed severe pain in the lower part of her back, which was thought to be a possible sacral sprain and she was strapped. *X*-ray taken at the time revealed no fracture. The pain persisted in the small of her back, radiating down her right buttock to the back of her right knee. One week later she suddenly noticed severe pain in both her ankles with numbness in her legs, followed almost immediately with complete paralysis of both her legs and bladder incontinence. The legs felt numb and "dead," and she could not move them from the bed, nor could she wiggle her toes. The patient was seen in neurological consultation by one of us (P. G. D.) on July 7, 1941, at the request of Dr. Robert Ackerly. There was a complete flaccid paralysis of both her legs and she could not lift her heels off the bed or wiggle her toes. Babinski sign was present with the fanning of the toes. The knee and ankle jerks were diminished, but bilaterally present and equal. Complete sensory loss to all forms of sensation was present below the second lumbar segment and perianal sensation was likewise completely lost. There was a band of hypalgesia extending from the level of the umbilicus to about the second lumbar segment. Above the umbilicus sensation was completely normal.

Urinalysis was completely normal. Red blood count 3,770,000 per cu. mm; hemoglobin 76 per cent, white blood count 9,900 per cu. mm. *X*-ray of the spine showed the thoracic and lumbar vertebrae completely normal. The patient was sent to the Post-Graduate Hospital where a lumbar puncture was performed, revealing a complete block. She was seen by Dr. John McLean in neurosurgical consultation on July 9, 1941. The neurological findings were the same as noted above and another lumbar puncture, with manometric determination, again revealed a complete block.

Laminectomy was performed on July 10, 1941, under local anesthesia. The cord was exposed by removal of the spines of the seventh, eighth and ninth thoracic vertebrae and seemed slightly swollen, but no gross defect could be noted. The dura was incised and slight vascular dilatation of the pia-arachnoid vessels observed, but no gross clot found. Gentle aspiration with a fine needle between the posterior columns revealed little of consequence. The outlook seemed grave indeed. Nothing of sufficient importance had been observed to make one believe that surgical procedure would be likely to aid the patient. It was thought that probably an intramedullary lesion had been sustained at the time of injury and that surgical intervention had been of little help. The next morning, however, to everyone's astonishment, the patient was found to have improved markedly and was able to lift her heels off the bed, abduct her legs slightly and wiggle her toes. A slight return of sensation was also observed in her legs. From this time onward improvement was very rapid, so that the patient was discharged from the hospital, with a slightly spastic gait, within two weeks, going through a rapid convalescence thereafter. In October, 1941, no neurological signs could be obtained, except for a slight band of hypalgesia below the umbilicus from Thoracic 10 to Thoracic 12 inclusive.

Nor was the pregnancy interrupted; the patient gave birth to a normal child in December, 1941.

The patient was seen for the last time on January 10, 1942, stating she had remained perfectly well, walking about normally with no impairment of bladder or rectal control. The only neurological finding noted, as above mentioned, was a persistent band of hypalgesia from Thoracic 10 to Thoracic 12.

Case v. A man of thirty-five was admitted to the Hospital, with a history of a blow to the back of his neck by a blackjack (?) the previous afternoon. He was immediately rendered unconscious with quadriplegia and incontinence. On examination, complete paralysis of all four limbs was present with loss of sensation to all modalities below the fifth cervical dermatome. *X*-rays of the spine were negative. This patient was seen in consultation by one of us (F. K.) five days after the injury because no improvement had occurred during this interval. He had been viewed as hopeless since it was believed that a complete transverse cord lesion was present. Operation was advised and laminectomy performed (Dr. DeWitt Stetten) on the sixth day following his injury, revealing "a fracture through both laminae of the sixth cervical vertebrae with slight depression of the fractured arch and blood extravasation around

the fracture lines. A curved spicule of bone ¾ cm. long was found pressing on the cord."

Three days after the operation, slight power in his lower limbs had returned, and on the fourth day it was noted that there was some movement in the arms. On the tenth day postoperatively, there was beginning return of sensation. From this time onward, continued improvement occurred so that four months after the injury, the patient was able to walk about the ward without any help, despite a slight persistent spasticity in his lower limbs.

DISCUSSION

Why do we favor early laminectomy in spinal column and cord injury, where the site of injury can be diagnosed?

1. Clinically, it is impossible to determine from the neurological examination at the time of the accident whether the cord has been completely severed, or whether function has been physiologically interrupted, (so-called "spinal shock"). We have repeatedly seen cases in which it was believed that a permanent, complete, transverse cord lesion had occurred, yet function, in varying degree, returned, despite an apparently hopeless prognosis at the start. Frazier,[3] Lambrinudi,[11] Verbruggen,[20] Lyerley[9] and others, agree with this observation. As Hamilton Bailey[36] has observed, "such paralysis does not signify that there is a complete lesion of the cord. Indeed it does not necessarily imply that the cord has been macroscopically damaged at all. . . . " Taylor[2] adds, "It is impossible to determine at the start whether or not it is a permanent, complete transverse lesion of the cord substance, since many apparently complete transverse lesions show spontaneous improvement after weeks or months." Allen's[1] experimental work on dogs, described above, is, in our opinion, conclusive evidence that this clinical observation is sound and true.

We stress these observations in some detail, since most neurosurgeons are reluctant to operate upon patients with so-called "complete transverse lesions" of the cord. Since all one can determine from the neurological examination is information as to the degree of *physiological* interruption in the spinal cord pathway, but not the degree of *anatomical* destruction, we believe that this argument in favor of conservative treatment, has almost no weight at all.

2. *X*-rays of the spine are by no means conclusive of fracture of the laminae or the spines, and, as our case reports III and V show, spicules of bone may be pressing on the cord without appearing on the *x*-ray film. After autopsy observation, Browder and Miner[37] in their interesting article, found that "negative *x*-ray findings do not necessarily exclude the possibility of a bone lesion." Many other good observers have said the same. As so often happens in laboratory medicine, positive data may be conclusive, whereas negative findings are not exclusive.

3. Cord compression, as shown by the finding of a manometric block (Queckenstedt) on lumbar puncture, is of course vital. It demands laminectomy. A manometric determination should always be done in the presence of a cord injury, despite objections by some observers as to the possible danger of this procedure. Admitting the slight hazard of manipulation of such injuries, this risk is truly little if proper care be taken. It must also be recalled that the manipulation associated with reduction is certainly not without its hazards, and this danger has been repeatedly stressed in the literature by such men as Munro[31] and others. In our thirty years of experience at Bellevue with such cord injuries, we have yet to see a fatality produced by careful lumbar puncture and manometric determination.

It can not be too strongly stressed that, in contrast to the increase in general intracranial pressure associated with head injuries, compression of the cord is here sharply localized. The level of cord involvement can usually be easily determined by simple clinical means. It is, therefore, reasonable to expect relief from laminectomy performed directly at the area of compression.

4. With the perfection of neurosurgical technique in the past generation, the operation of laminectomy has become less dangerous by a good deal than is a diagnostic laparotomy. We have already quoted Leriche,[8] Stetten,[35] Frazier[3] and others, regarding the safety of this procedure. Certainly, when one faces the gravity of this condition, likely to cripple and shorten life, the small operative mortality associated with laminectomy should weigh little in the decision.

5. Even the conservative surgeons, despite themselves, have had their successes. Occasionally, dramatic cases of improvement following laminectomy have been observed: Elsberg,[14] Davidoff,[38] Grant,[10] etc. The argument that a similar result might have resulted after conservative treatment seems beside the point, since a well controlled, conclusive series has not been obtained. Our Case IV is illustrative. Even if only one case in a hundred were helped by laminectomy and saved from a life of helpless invalidism, this operation should be resorted to, since no other choice is open. The situation is one in which there is nothing to lose and everything to gain, even if it be admitted, which we do not admit, that it is only the rare case that can be aided by operative intervention. We are aware of the unusual experience of a surgeon in which laminectomy revealed a pulped cord, which, on splitting the dura, was extruded like ooze. In such cases, though the operation was of no help since the cord was irretrievably damaged in the first place, it did no harm.

No statistically valid series has yet been reported in which similar patients were alternately treated radically and conservatively (by laminectomy or by traction). We advocate such a study, which should be conclusive.

6. If operation be decided upon, laminectomy should be performed early. These cases are surgical emergencies. As soon as, in the judgment of the operating surgeon, the patient is sufficiently out of general shock and able to withstand the procedure, let him waste no more time. Frazer[3] stated roundly, "if the operation is to be performed at all, it should be done at the earliest possible moment; . . . the risk of early or immediate operation has been overestimated if my own experience be any criterion, since in a series of twenty operations there has been but one fatality." Grant[10] also believed that time is the essence of the problem, stating that "unless existing pressure on the cord is relieved within eighteen hours, damage will be permanent." Though the arbitrary time limit may be open to question, as is demonstrated in our illustrative cases, we agree completely regarding the need of early intervention.

The arbitrary statements about a waiting interval of from two to six weeks to allow "spinal shock" to subside are sheer nebulosities and need no longer hamper action.

SUMMARY AND CONCLUSIONS

1. The literature of fractures of the spine with spinal cord injuries has been reviewed.

2. Indications for laminectomy in spinal cord injuries have been discussed; more frequent operative intervention has been advocated for these reasons: (a) It is impossible to determine clinically, whether an apparently complete transverse lesion of the cord is not really a temporary physiological interruption of function. (b) Negative *x*-ray findings cannot for certain exclude a bony lesion of the spine. (c) Prolonged cord compressions, as manifested by manometric block, can destroy cord function, and its early relief by surgery may cure. (d) The operation of laminectomy is associated with little risk.

3. No statistically valid series of cases exists, in which the patients were alternately treated by laminectomy or conservative régime. We advocate such a study.

4. If operation be decided upon, laminectomy should be performed early. These cases are surgical emergencies.

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MULTIPLE CARCINOMA*

THE CLINICAL PICTURE, DIAGNOSIS AND PROGNOSIS

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THE literature on multiple carcinoma is extensive but does not include any review of all the published material on the clinical picture, diagnosis and prognosis. Multiple primary carcinoma occurs in different organs and organ systems. Therefore, the clinical picture, the diagnosis and prognosis of multiple carcinoma are quite different in different cases. That may be the reason why a summary description is absent in the extensive literature of multiple carcinoma. For instance, the monographs of Warren and Gates,[1] Anderhub,[2] Cokkinis,[3] H. E. Bacon[4] and others do not mention them at all. I think it is very worth while to try to give such a description of the clinical picture, diagnosis and prognosis of multiple carcinoma.

Frequency. At the Presbyterian Hospital multiple primary cancers occurred in thirty of 685 autopsies upon cancer cases, i.e., 4.33 per cent. This is in fair agreement with the statistics in the literature. Warren and Gates in a study of recorded cases found a general incidence of 1.84 per cent, and in their own series of 1,078 cancer cases, the frequency was 3.7 per cent. Hurt and Broders[5] found 3.34 per cent in 2,124 cancer patients.

Classification. According to *site* three cases arose in the same organ (stomach, colon, breast). In twenty-four of the thirty cases, one of the tumors originated in the digestive tract; and in eleven of the thirty cases, the multiple cancers arose exclusively in the digestive tract. Among a total of 685 autopsies upon cancer cases, there were 295 cases (43.06 per cent) in which the cancer was primary in the gastrointestinal tract. There is thus a decided predisposition toward the formation of multiple primary tumors in the digestive tract.

According to *time* of appearance twenty-one cases, including three which are uncertain, have been synchronous, and nine (one uncertain) metachronous.

According to *histologic structure* in four cases the primary cancers presented an identical histologic structure, in twenty-six a diverse one. In twenty-four cases, the multiple growths were carcinomatous; in one case, a sarcoma and carcinoma occurred simultaneously; in another case, there was a mixed carcinosarcoma.

There were no significant conclusions to be derived from an analysis of sex, age or race. Familial incidence was no higher in the cases of multiple tumors than in the single ones.

Congenital anomalies were found more frequently in cases of multiple cancers than in single cancers or in noncancerous patients. The relative incidence of anomalies in these three groups was seventy-seven multiple, sixty-six single, and fifty noncancerous. There was also a higher incidence of multiple *benign* tumors in the individuals bearing multiple primary malignant tumors than in the single cancer cases or in the noncancerous subjects. The proportional incidence for the three groups was fifty-eight multiple, twenty-four single, and thirty-three noncancerous.

In 1916, Harbitz[6] emphasized the fact that carcinoma is quite often found in association with one or more tumors having congenital background. Rössle,[7] in 1920, made similar observations on a large amount of material, and expressed the opinion that the association of cancer with

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benign tumor and anomalies is so much greater than the expected frequency as to point to a constitutional predisposition. Siebke,[8] in 1926, on the basis of the writings of Rössle, Harbitz, Bartel,[9] Egli,[10] Swilenski[11] and others, came to the conclusion that multiple cancers are of great interest and importance from the point of view of constitution. He urged the reporting of benign tumors, hematoma and malformations in such cases, as well as the recording of their absence. This suggestion has been carried out by Anderhub in his two negative cases. According to Cokkinis, the figures quoted by Warren and Gates show that the incidence of multiple primary malignancy is many times greater than the calculated incidence based on chance. John C. Bugher[12] says that there is an inherent susceptibility to cancer not possessed by all people, and Carl V. Weller[13] agrees with him. The nature of this predisposition according to Warren and Gates is unknown.

Congenital anomalies have occurred more frequently in our thirty cases of multiple cancer than in single ones, or in noncancerous cases. This may support the idea that the cells which give rise to cancers may themselves be congenitally abnormal. *Heredity* may be an intrinsic factor in the origin of multiple tumors. Recklinghausen's hereditary multiple neurofibromatosis, associated with deafness, bilateral acousticus tumors, multiple meningiomas and gliomas in various combinations (Cushing[14]) is an example.

Hormonal stimuli may be another significant factor in the origin of multiple tumors and cancers. Dyshormonal influences are assumed in cases of cancer of the breast, the uterus, the ovaries (Sampson) and possibly the prostate.

It may be that, under certain circumstances, congenital anomaly, heredity, or hormonal stimulus, may separately or in combination with each other lead to the formation of multiple carcinomas.

A review of the clinical data of our thirty cases of multiple cancers gave no certain evidence of any hereditary or dyshormonal influence. Regular assays of blood and urine for sex hormones in cases of multiple cancers may give in the future more evidence of dyshormonal disorders. Following the experimental work of Davidson,[15] Genkin and Dimstruck,[16] Murray, Woglom and Cramer[17] it has to be established by new experiments whether it is possible to produce multiple cancers similar to that found in the human body by means of hormonal stimulation.

The material of the thirty multiple primary cancer cases on the basis of autopsy mentioned above will be used for the description of the clinical picture and diagnosis of this disease. Moreover, thirteen other only clinically observed cases of multiple cancers, of which five are living and eight are dead, will be used to give a picture of the *prognosis* of the disease of multiple cancers.

CLINICAL PICTURE

We have to separate the synchronous cases from the metachronous. Multiple primary cancers are *synchronous* when they are present simultaneously. Multiple primary cancers are *metachronous* when they originate after the operation of a first cancer. The clinical picture of these two kinds of multiple cancers is different.

Multiple cancers affect the host just as any cancer does. But the clinical picture of multiple cancers must be different from that of single cancers. The clinical picture of twenty-one synchronous cancers will be treated first, showing (1) the general effect on the vital powers as a whole, (2) the local effect, which may produce a general effect, and (3) the effect of metastases. It is clear that if two or more primary cancers originate in different parts of the same organic system or in different organic systems, very different effects may appear in the clinical picture than would appear if the cancers were in the same place.

An *intestinal obstruction* produced by two different cancers on two different parts of the bowel may produce an especially

stormy picture. A second example of a double effect by a mechanical obstruction of the lumen of two different hollow organs by double cancers was found in one of our cases. Here the right bronchus was narrowed by a cancer and the right ureter was shut by a tumor of the urinary bladder. The clinical picture was characterized by asphyxia and a hindered discharge of the urine.

If a cancer produces a perceptible, clinical effect by a stricture, we may be justified in suggesting also a simultaneous biochemical effect (that is, an alteration of metabolism, loss of weight, cachexia, etc.) due to those cancers accidently found in the same cases at autopsy and which were not diagnosed clinically. Such an example is that of a patient in whom there was a carcinomatous stricture of the sigmoid and a clinically undiagnosed annular crater of the duodenum.

Another kind of mechanical and simultaneous biochemical effect may result from double cancers, if they both invade the same organ and so eliminate in a mechanical way tissues which are useful for the general biochemistry of the body. In one of the cases in this series there were dyspnea and orthopnea caused by two independent cancers in the lower lobe of the right lung.

The *formation of metastases* influenced strongly the picture of the disease of multiple cancers in other cases. In one case an ulcerated, inoperable cancer of the breast with extensive metastases in the axillary glands lasted a year. It was associated with a cancer of the rectum, which made a stricture of the bowel of three months' duration, and ended with extensive metastases in the cavities of the peritoneum and the chest, with perforating peritonitis.

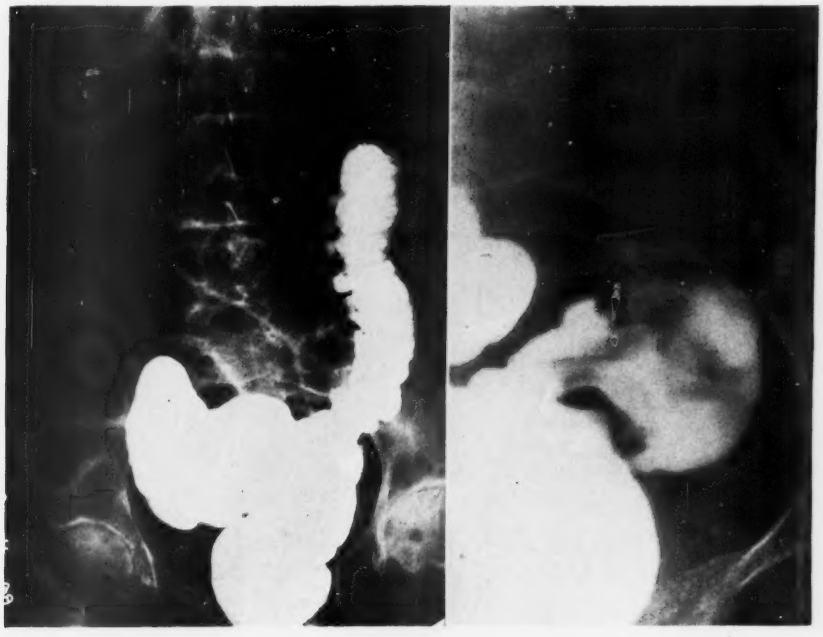
In another case the obstruction of the bowels was explained by a clinically diagnosed cancer of the rectum (polyp), but the numerous metastases to the liver, which gave the characteristic feature to the clinical picture by their violent pain in the epigastrium, originated from a cancer of the head of the pancreas, found only at autopsy.

In still another case a clinically diagnosed cancer of the fundus of the gallbladder or the tumor in the region of the gallbladder probably explained the constant pain in the right upper quadrant. But the general peritoneal cancer with ascites and the extensive metastases into the liver and the lungs which arose from a cancer of the great curvature of the stomach, found only at autopsy, may also have been responsible for the constant pain. In any case, the metastases would certainly have made the pain greater.

In one of the cases in this series the icterus gravis was produced by a cancer of the bile duct with a large node in the right lobe of the liver and with regional lymph gland metastases. The extensive spreading carcinoma of the peritoneum, which added to the especially serious character of the clinical picture, originated in a cancer of the right ovary. This was not diagnosed during life, and not recognized at autopsy but was discovered later by the microscopic examination.

The following data are characteristic both as a clinical picture of metastasis and from a pathological standpoint: In this patient the disease lasted thirty-one years. The patient had had a pruritus-ani first, then she had four primary cancers in the anal region within ten years. In the eleventh year she had a biopsy of the uterus, which showed a beginning cancer of the cervix. This cancer was healed locally by *x*-ray, but then she showed the picture of a general carcinoma of the peritoneum probably caused by a carcinomatous occlusion of the thoracic duct. In the meantime, half a year before death, she had a growth in the left supraclavicular region, which looked like a carcinomatous Virchow gland. But after an aspiration of fluid with *no* cancer cell tissue, it was thought to be a varix of the thoracic duct. Later on, however, the microscopic examination of the tumor removed at autopsy showed cancer, not

only in the lumen and the wall of the thoracic duct but also in the nodule mentioned above which was the remains of a lymph gland. Hence, it was a carcinomatous Virchow gland replaced by metastases and adjacent to an enlarged part of the thoracic duct.



A B

FIG. 1. A, shows a complete obstruction at the splenic flexure and distention of small enlarged intestine proximal to the lesion. In addition numerous diverticula of the descending colon are seen. B, a spot film shows irregularity and constriction of the lumen at the junction of the sigmoid and descending colon.

In other cases there were complications caused by the *cancer itself* which changed and influenced the clinical picture. Twice a biliary cirrhosis of the liver as a result of the cancer was found: (1) In one case three weeks before death, an icterus gravis suddenly occurred. The biopsy showed a biliary cirrhosis of the liver. The cause was a cancer of the head of the pancreas, which obstructed the choledochous duct. (2) In another case an unknown cancer of the esophagus had metastasized in the retroperitoneal lymph gland. This large tumor mass obstructed the choledochous duct and produced a biliary cirrhosis of the liver. Hence, the presence of icterus gravis, the white diarrhea and the extensive ascites.

The clinical picture was also complicated occasionally by diseases, which were independent of the cancer: The clinical picture in one case was characterized by (1) symptoms in the lung starting from the cancer of the lung, and (2) complication of a progressive paralysis of the right half of the body and of the speech center caused by a left meningioma, which pressed and necrotized the left central lobe of the brain. The simultaneous sigmoid cancer produced no clinical symptoms. Metastases of the lung cancer in the occipital lobe of the brain had not changed the clinical picture.

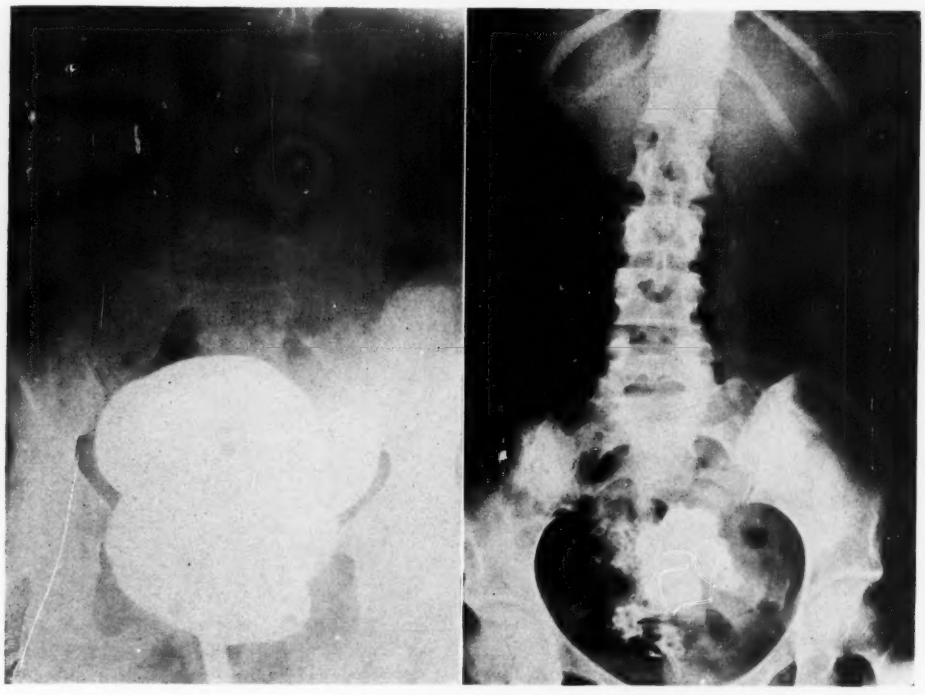
Finally, there are the data of the clinical picture of synchronous multiple cancers which occurred in a man who had reached the age of seventy-two years with: (1) bronchiectasies in both lower lobes, (2) a moderately developed cirrhosis of the liver, (3) a fresh tuberculosis peritonitis with miliary tubercles in the spleen, the liver and an epigastric lymph gland, in which were found a moderate number of tubercle

bacilli, and (4) three primary multiple cancers.

The appearance of the metachronous cancer occurred within periods ranging from fourteen days to sixteen years after the establishment of the first cancer. The first cancer occurred seven times in the digestive tract in the nine cases of metachronous cancer, i.e., 77.80 per cent of all. Of these 7 cases, the first and the metachronous cancers developed five times in the digestive tract, and twice the first cancer was in the digestive tract and the metachronous cancers were in the bronchus or in the urinary bladder.

Carcinomatous strictures occurred in six cases; four times in the first and the metachronous cancer, once in the metachronous cancer only, and once in the first cancer. It shows the important part played by stricture formation in metachronous cases and the importance for the clinical picture.

The loss of weight and the curtailed duration of human life are in general a result of the growth of the cancer itself. There may be rare exceptions[18] and it is interesting to read that according to Cramer there is a great difference between animals and human subjects.[19] Hence whatever may be the cause of cachexia in cancer bearing patients, it is apt to be more extreme in cases of multiple than of simple cancers. In twelve cases of synchronous multiple cancers, which offered a clinical picture influenced by two or more multiple cancers, eight showed great weight loss. In four cases there was weight increase due to fluid in the pleural, pericardial and peritoneal cavities.



A B

Fig. 2. A and B, show a constricting lesion of the sigmoid and in addition polyps of the rectum.

A. P. Stout[20] has given the average duration of life for a number of cancers but not for multiple cancers. Our cases of multiple cancers were compared with the average numbers of Stout, wherever they were available. The attempt was made to find out if there were any great differences and if it were possible to draw any conclusions from them. We have seen, that in eight synchronous cases of the twenty-one, which had multiple cancers, the dura tion of life had been shortened consider-

ably, as compared to the average figures for duration which Stout has given us. In this connection it seems irrelevant that Stout has given us only the average duration of *one* cancer in most of these multiple cancer cases; but it must be pointed out that in all eight cases there were no other complicating causes of death, independent of the cancer itself. *This shortening of the duration of life can be explained only* by *the synchronous effect of the multiple cancers on the body.*

accelerated by synchronous multiple cancer cases as compared with corresponding metachronous cases. That may be the simultaneous effect of multiple cancer on the body.

RELATIONSHIP OF POLYPOSIS UNIVERSALIS TO MULTIPLE CANCERS OF THE DIGESTIVE TRACT

The question of *polyposis universalis* of the digestive tract was raised only in three

TABLE I*

Case	Metachronous Cancer	Duration of Life	Case	Synchronous Cancer	Duration of Life
15	In the colon transv. after former cecum ca. 16 years before.	10 months	1	3 Multiple colon ca.	3½ months
30	In the cecum after form . of enic flexure a ca. of rectum 14½ mo. after 1st operation.	9 months	1	3 Multiple colon ca.	3½ months
3	In the sigmoid after former appendix ca. 3 years and 2 mo. before.	2¼ months	22	1. Sigmoid ca. 2. Ca. of bile duct.	1¼ months
25	In the esophagus after former ca. of tonsil. 3½ years after healing by *x*-ray.	13¾ months	2	1. Esophagus ca. 2. Stomach ca.	6¼ months
26	In the bronchus after former breast ca., 2½ years after mastectomy.	21 months	4	1. Ca. of bronchus 2. Ca. of bladder	12 months

* Due to lack of space lengthy tables submitted originally with this article have not been included.

If this is correct, we may expect *a greater duration* of life in the *metachronous cases* of multiple cancer, because only one is effective at a time. Indeed that is the case in five instances. Table 1 shows the greater duration of life in five metachronous cases of multiple cancers in relation to five corresponding synchronous cases of multiple cancers.

In three of these five metachronous cases it was noticed that the loss of weight was smaller than in the corresponding synchronous cases of multiple cancers. This small series is reported here in hopes that similar observations may be made in a larger series. But even this small group of cases creates the impression that the duration of life is shortened and weight loss

metachronous cases: (1) In one numerous benign polyps occurred in the colon, and neither the cancer of the appendix nor the cancer of the sigmoid showed any microscopic relation to the formation of polyps. (2) In another case the cancer of the jejunum itself showed an apparent relation to the formation of polyps; however, the earlier cancer of the cecum and the later cancer of colon ascendens did not show this relationship. Other polyps were absent. (3) In a third case there were five cancers of the intestine, three of which were metachronous colon cancers. The metachronous cancer of the cecum turned out to be a large carcinomatous polyp. Two other small, early carcinomatous polyps occurred close by. But also the cancers of the splenic

flexure and of the rectum resected one and one-half years before showed microscopic relations at that time to the polyp formation. Other single polyps did not occur anywhere in the intestine.

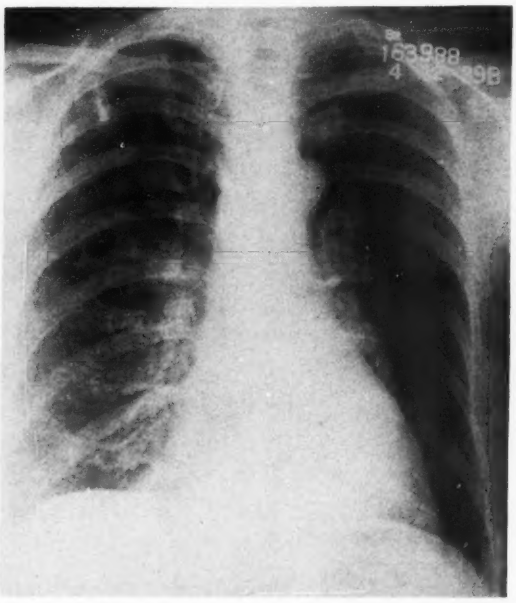


Fig. 3. Shows a mass in the left lower hilar region, diagnosed by Dr. Ross Golden as a primary cancer of the bronchus. Autopsy confirmed this finding.

INFLUENCE OF MULTIPLE CANCERS ON THE BLOOD

The question to be investigated was whether the influence of cancer on the blood would appear stronger in the multiple cancers than in single ones. We know that cancer is followed often by an anemia, which occasionally tends to resemble the pernicious type. Hence, the hemoglobin percentage and the number of red blood corpuscles of the thirty multiple cancers reported have been compared with those of thirty simple cancer cases. This comparison was also made, eliminating cases with hemorrhage in both groups. In another paragraph the metachronous cases were excluded comparing only the synchronous cases of the two groups. In the metachronous cases the first cancer is often removed long before the second one appears. Consequently in such instances there cannot be any influence of a *multiple* cancer on the blood, because there is only *one* cancer present at one time.

There are no remarks about the quality of the red blood corpuscles in the records, so these cannot be reported. The white corpuscles will not be discussed, although detailed remarks are available, because the cancer itself seems not to have any great influence on it. The hemoglobin average of multiple synchronous cancer shows small differences, which may be entirely related to normal fluctuation. The normal average hemoglobin per cent in metachronous cases, after eliminating the first cancer, may be reached. The impression is given that the quantity of the red blood cells has been reduced by multiple cancers more than by simple cancers. If this is correct, that may be due to the natural influence of the multiple cancer on the blood, which must be greater than that of the simple cancer cases.

To decide whether it would be possible to use a stronger reduction of the hemoglobin percentage and of the number of red blood cells as an added test in cases of suspicious multiple cancer, one would need quite a large number of multiple cancers.

CLINICAL VALUE OF THE PHOSPHATASE DETERMINATION IN THE BLOOD IN MULTIPLE CANCERS

One other possible laboratory approach is through the study of phosphatase in the blood. The question of the value of phosphatase determination, however, in these cases is not clear at this time. Lubinstein[21] thinks that the phosphatase is valuable. Gutman,[21a] on the other hand, believes the value of phosphatase is small until metastases appear either in the bones or the liver. Our experiences seem to suggest the advisability of making this test regularly in such cases. Perhaps it would be worth while to compare the results of other biochemical findings in multiple cancers with those of simple cancer cases. There are at present few reports of that nature in the literature.

DIAGNOSIS OF MULTIPLE CANCERS WITH PARTICULAR REFERENCE TO X-RAY EXAMINATION

We have twenty-one *synchronous* cases of multiple cancers. In eight of those cases the second cancer was an accidental finding. In one series of thirteen cases the correct diagnosis was made in four instances during life:

Case I. Five days after a cecostomy for ileus the barium enema examination disclosed two cancers, one at the splenic flexure, and a second one in the descending colon (Fig. 1A and B). Eleven days later the diagnosis was confirmed when a colostomy was done. The proctoscopic examination was negative.

Case II. This patient had cancers of the right breast and of the rectum. The latter was detected by barium enema and *x*-ray although the proctoscopic examination failed to disclose it.

Case III. This involved two cancers of the right breast demonstrated by biopsy.

Case IV. A carcinosarcoma of the left ovary was disclosed by laparotomy and biopsy.

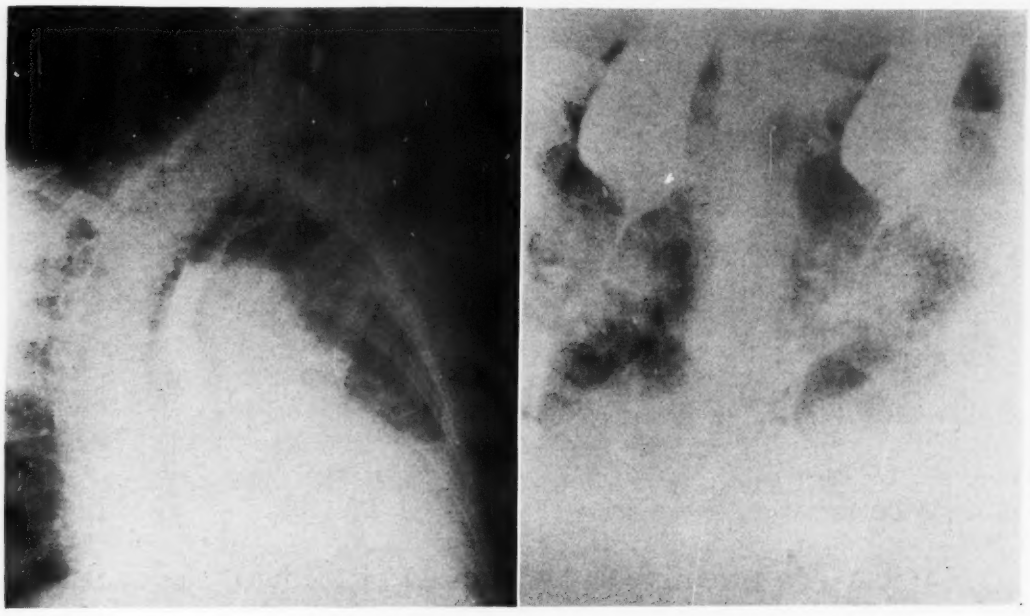
In six of these synchronous cases of multiple cancers only one or two of the multiple cancers were diagnosed during life. Undiagnosed were: (1) A duodenal cancer shown at autopsy. Here the proctoscopy and the barium enema had shown a sigmoid cancer (Fig. 2A and B), and the operation (colostomy and resection) had demonstrated the cancer of the colon transversum. (2) A sigmoid cancer. Here the laparatomy had shown a cancer of the bile duct. An *x*-ray examination of the sigmoid (barium enema) was not done. The gastrointestinal series showed stomach and small intestines not changed. (3, 4 and 5) A cancer of the stomach in the three cases. *X*-ray examinations of the stomach were not done. (6) A cancer of the pancreas. Two *x*-ray examinations led to the erroneous conclusion of an ulcus simplex duodeni. The simultaneous cancer of the rectum was diagnosed by proctoscopy with biopsy. Metastases of cancer in the liver were recognized by an explorative laparatomy with biopsy. They were thought to be derived from the cancer of the rectum, but the later microscopic examination showed them to be of pancreatic origin.

In three of these cases the multiple cancers were not diagnosed during life at all: (1) A cancer of the bile duct and a cancer of the ovary. An *x*-ray examination of the colon and one of the gallbladder were negative. A biopsy of the ligamentum suspensorium in an exploratory laparotomy established only a cancer of unknown origin with a number of peritoneal metastases. (2) A cancer of the bronchus and a cancer of the urinary bladder. A bronchoscopy and four *x*-ray examinations of the lung did not lead to a positive result. A cystoscopy was not done. Besides other vesical symptoms, hemorrhages of the urinary bladder were also seen. (3) A cancer of the stomach and two cancers of the lung, among them a small primary oat-cell cancer and a large secondary cancer of the lung of unknown origin. An *x*-ray examination without result was done in this case. An *x*-ray examination of the stomach was not done.

These cases have shown the importance of an exact clinical diagnosis. Examinations were made by *x*-rays, biopsy, and the use of bronchoscopes, esophagascopes, gastrascopes, etc. Where complete *x*-ray examinations of the entire gastrointestinal tract were *not* made, some cancers were overlooked. Four cancers of the stomach, of which three were large ones, and a great cancer of the duodenum were not recognized. In all these four cases no *x*-ray examination was done. It seems clear that an *x*-ray examination of the *entire* digestive tract should be done in all dubious cases.

A critical review of the diagnosis of the *metachronous* multiple cancers leads to the following results: In eight metachronous cases the diagnosis of the first cancer has been made eight times by microscopic examination. A ninth case will be discussed at the end of this section. In five of the eight cases mentioned *the diagnosis of the second, i.e., metachronous cancer has been made during life:* (1) A sigmoid cancer by

x-ray, by resection of the sigmoid, and by biopsy; (2) a cancer of the uterus by biopsy of the uterus; (3) a bronchus cancer by bronchoscopy (with doubtful result), by biopsy of an expectorated piece of tissue and by seven *x*-ray examinations, of which three were positive. In this case because of the peculiar *x*-ray finding Dr. Ross Golden made the diagnosis of a primary cancer of the bronchus. (Fig. 3.) (4) A cancer of the esophagus by a positive esophagoscopy and three *x*-ray examinations, twice with a positive result. (Fig. 4A and B.) (5) A cancer of the bronchus by *x*-ray examination of the lung. However, this finding was interpreted during the life as a metastasis of the cancer of the splenic flexure, which was removed years before.



A B

FIG. 4. A, shows no evidence of cancer of esophagus; B, shows an extensive carcinoma of the middle third of the esophagus.

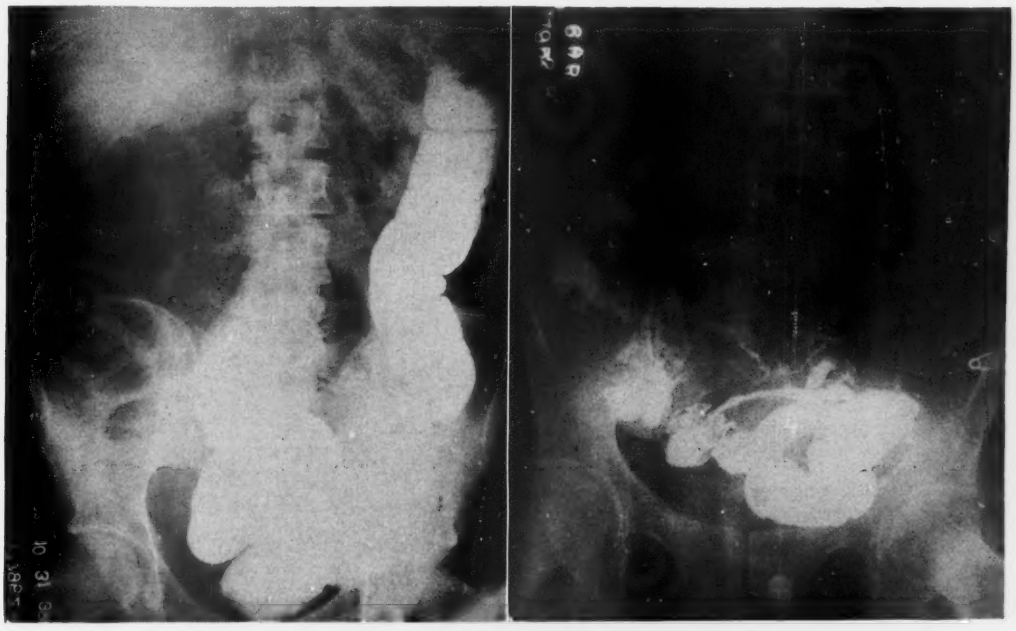
Three times in the above mentioned eight cases the diagnosis of the metachronous cancer was not made during life: (1) A large cancer of the urinary bladder (7.5 by 1 cm.). Neither symptoms nor metastases appeared. (2) A cancer of the colon ascendens. Sixteen years after the resection of the cecum because of an adenocarcinoma a colostomy had to be done suddenly during the night because of an ileus. An *x*-ray examination postoperatively was without diagnostic results. (3) A cancer of the cecum. Twenty months after the diagnosis and after the operation of two synchronous cancers of the colon, autopsy uncovered a great, annular, obturating crater in the cecum, in the middle of which a large polyp was prominent. An irregular, intraperitoneal abscess cavity communicated with the lumen of the cecum. An *x*-ray examination had been made seven months before death. The possibility of a new primary cancer was considered, but the diagnosis of "regional ileitis" was made, because it was thought not likely that a third primary cancer would have originated in the colon. (Fig. 5.)

In this relation the following data are instructive: In thirty multiple cancer cases we had three cases with three or more multiple colon cancers:

Case No.	No. of Cancers
1	3 Colon
9	3 Colon
30	4 Colon, 1 Rectum

We have thus in 10 per cent of the multiple cancers three simultaneous colon can-

cers. It is therefore not unlikely, after having had two colon cancers, that a third primary colon cancer is present and it is absolutely correct to consider this possibility if the symptoms agree with it. Retrospectively, the picture of the *x*-ray in one of the cases (Fig. 5A, B, C) reminded one very much of an obturating cancer of the cecum, but it is doubtful if an operation half a year before death would have been successful, because the metastases of this tumor in the retroperitoneal lymph



A B

C

FIG. 5. A, shows a complete obstruction to the retrograde flow of barium suspension at the *splenic flexure*. The growth known to be in the *rectum* is hidden by the barium suspension which distends and fills this region. B, shows a large irregular defect in the contour of the cecum and terminal portion of the ileum. C, shows the defect in the cecum to persist by the barium suspension, which distends and fills this region.

gland, liver and lung shown in autopsy were very extensive.

This case, therefore, is very instructive,

Fig. 6. Shows a constriction of the pyloric antrum and a large crater on the greater curvature site. The *x*-ray appearance is not suggestive of a malignant lesion, but of multiple ulcers. At autopsy this was proved to be a carcinoma.

because the first two cancers of the intestine were established by *x*-ray examination, the rectum cancer by barium enema, the cancer of the splenic flexure by a gastrointestinal series, and because two successful large operations of the intestine were performed.

A case between the synchronous and the pure metachronous will now be discussed. In the beginning of the disease the diagnosis of the first cancer (pyloric cancer) was *not* made. After three *x*-ray examinations, (Fig. 6) the opinion was that an ulcus duodeni was present, and a gastroenterostomy was performed. A year later, a barium enema was given, but because of spasms only a poor *x*-ray resulted. Because of the other clinical symptoms, the diagnosis of a cancer of the sigmoid and a cancer of the stomach or the ovary with metastases was made. The autopsy showed an annular, obturating adenocarcinoma of the sigmoid and an obstructing cancer of the pylorus.

Investigation of the metachronous multiple cancer cases shows that the *x*-ray examination had been applied very extensively, (for instance, in one case *seven* times in all). The *x*-ray examinations gave *five positive results in seven cases* of metachronous cancers. The reason for the careful and repeated *x*-ray examination was probably the fact that a certain cancer had already been diagnosed.

IMMUNITY IN MULTIPLE CARCINOMA

Boyd[22] maintains the view that the presence of one carcinoma affords immunity against the development of a second one. He says: (1) Acquired immunity to cancer (artifically produced) is common in mice. When a cancer, either produced by tarring or occurring spontaneously, is removed and the mouse tarred again, no tumor will develop. The presence of one tumor usually confers an immunity which prevents another from developing. (2) For this reason multiple malignant growths are remarkably rare. (3) Cancer of the rectum and to a much lesser degree of the large bowel is often preceded by the development of a papilloma or adenoma. These papillomas may be multiple but when one of them becomes malignant, the others tend to disappear so that at the autopsy, none may be observed. The change is best seen in surgical specimens removed at an early stage. (4) Multiple papillomas in adenomatous polyps may recur in any part of the intestinal canal . . . they have a strong tendency to become malignant. The carcinomatous change occurs only in one papilloma.

It seems to be true that multiple carcinoma is of exceptional occurrence. In thirty-six years of clinical practice, I have seen but one case, a carcinoma of the uterus, which I removed, and three and one-half years later, an early carcinoma

of the breast.[23] Among the thirty cases here reported, there was only one uterine cancer. In the literature, up to 1935, there were but three recorded cases of uterine and breast cancer. Generally speaking, however, multiple carcinomas are *not* "remarkably rare," as Boyd alleges, since in the Presbyterian Hospital autopsy records, 5 per cent of all cancers were multiple. With increasing histological experience and thoroughness, the percentage would probably be even higher.

Nor is there complete agreement with Boyd's remarks about immunity in multiple cancer of the digestive tract. Four of our cases are not in accord with his statements.

In one case a carcinoma of the colon had been removed by resection and another of the sigmoid by protectomy. A year later, a third carcinoma arising in a polyp, was found at autopsy in the cecum, and two additional carcinomatous polyps in the colon ascendens.

In a second case a carcinoma of the cecum with papillary growths was resected. Sixteen years later, following an urgent colostomy, a second primary carcinoma of the colon and a beginning carcinoma in a jejunal polyp were disclosed at autopsy.

In a third case a carcinoma of the appendix was removed. Three and one-half years after the operation, a cecostomy and resection of the sigmoid were performed. The surgical specimen contained a cancerous polyp of the sigmoid and three other polyps; and at the autopsy, ten days later, numerous polyps of the colon and sigmoid were found.

In a fourth case a carcinomatous polyp of the transverse colon was removed by excision; eleven days later a portion of the colon was resected, and this contained 120 polyps. At autopsy, nineteen days after the first operation, there were found: (1) A duodenal cancer with a papillary structure suggesting a polyp origin; (2) a carcinoma of the sigmoid, very suggestive of a polypoid structure; (3) a carcinomatous polyp of the jejunum, and (4) numerous polyps in the small intestine, over a distance of 50 cm. distal to the duodenal cancer, and also in the colon and lower segment of the sigmoid.

Two cases with polypoid cancers, three of which definitely had originated in polyps, show that the development of multiple primary cancer, contrary to the statement of Boyd, is not prohibited by the appearance of malignant changes in a single polyp.

PROGNOSIS

Of thirteen clinical cases of multiple cancers during 1923 to 1940 in the Presbyterian Hospital five patients are living. The five cases are the following:

CASE I. The patient, sixty-two years of age, with multiple cancer (metachronous) had a (biopsy of larynx) performed on September 23, 1937, and a squamous cell epithelioma of the larynx was diagnosed. It was too far advanced for laryngofissure; it was well differentiated and had not invaded the underlying tissue to any great extent. Total laryngectomy "seems to have been completely removed." On March 30, 1939, an alveolar adenocarcinoma of the prostate was found and transurethral resection of the prostate was performed. There was no evidence of recurrence on January 4, 1941.

CASE II. This patient, forty years of age, had multiple cancer (metachronous). It was typically adenocarcinoma of the transverse colon in the hepatic flexure; there was a hard mass which was not adherent; there were no metastases in a lymph gland or anywhere else. Operation on November 23, 1923, consisted of partial colectomy, resection of ascending cecum and part of the transverse colon and ileocolostomy. A fairly well differentiated adenocarcinoma of the rectum penetrated the muscle layer and perirectal fat but there was no blood vessel invasion. A biopsy performed on November 28, 1939, was somewhat similar to the previous one but was more differentiated. There were no metastases in forty-six lymph glands. On December 4, 1939, abdominoperineal resection was performed and the prognosis was relatively good. On May 28, 1941, the wound had healed, the colostomy was working well and the patient had no complaints.

Case III. The patient, thirty-seven years of age, had multiple cancer which was metachronous. She had carcinoma of the left breast with metastases to the axillary lymph-nodes. *X*-ray radiation was used and on April 26, 1933, radical mastectomy performed. Small lymph-nodes in the axilla had been invaded. No radiotherapy was used postoperatively. There was a fairly well differentiated group of tumor cells with metastases to two small lymph-nodes. Papillary adenocarcinoma of both ovaries developed and on March 3, 1939, supravaginal hysterectomy and bilateral salpingo-oophorectomy were performed. On April 25, 1941, the patient weighed 144 pounds and there were no metastases.

Case IV. The patient, a sixty-nine year old woman, had multiple cancer of the synchronous type. On February 23, 1939, she had a basal cell carcinoma of the skin of the forehead the base of which was covered with a reddish brown, dark, superficial crust. The borders were markedly raised and poorly infiltrated. She gave a history of having been hit by a nail. The pathological report was missing. *X*-ray treatment had been given. On March 22, 1939, adenocarcinoma of the rectum was diagnosed. There was an annual constriction of the rectum, 8 cm. long, the borders of which were knobby, hard, tender and irregular. A finger could not be inserted through the opening. This was a moderately well differentiated tumor which had not metastasized to any of the thirty-six lymph glands found. The prognosis was good. Operation consisted of abdominoperineal resection of the rectum and sigmoid colostomy. On May 13, 1941, the patient had gained weight and there were no evidences of metastases.

Case V. The patient, a forty-seven year old woman, had synchronous multiple cancer. She had a multilocular papillary serous cystoadenocarcinoma of both ovaries. On March 11, 1938, supravaginal hysterectomy and bilateral salpingo-oophorectomy were performed. In the area of the right ovary a large fungating mass perforated the former ovarian capsule in several places and this condition existed in the area of the left ovary also. There was no ovarian tissue present. On June 20, 1941, no bleeding, discharge or pain were present. The patient weighed 154 pounds and the pelvis was clear.

Of *the three metachronous* cases which are living, the interval in Case I between the first cancer and July 1, 1941, is four years, between the second cancer and July 1, 1941 is two and one-fourth years; in Case II between the first cancer and July 1, 1941 the interval is seventeen and one-half years, between the second cancer and July 1, 1941, the interval is one and one-half years; in Case III between the first cancer and July 1, 1941, there is an interval of eight and one-fourth years, and between the second cancer and July 1, 1941, there are two and one-fourth years.

All these three cancer cases cannot be described as perfectly healed, because they have not reached the five-year term, but it is very interesting to see that in Case III, with eight and one-fourth years and Case II, with seventeen and one-half years, the first cancer can be said to be absolutely healed postoperatively. There is also the hope for healing of the second cancers. Also, *in the two synchronous* cases, Case IV with three and one-fourth years after operation and Case V with three and one-fourth years after operation, both patients are still in good health, but the five-year limit has not been reached. However, there is good reason to believe that all the five patients will be absolutely cured. Therefore, the prognosis in multiple cancer treatment is not altogether hopeless.

SUMMARY

1. A clinical analysis of thirty cases of multiple cancers has brought out the fact that the period from the first appearance of symptoms until death was shorter in cases of multiple primary malignant growths than in single ones; the weight loss was also considerably greater.

2. The correct diagnosis of multiple cancer was made during life in four of the synchronous and in five of the metachronous cases. It shows very clearly how much the diagnosis of cancer owes to radioscopy. *X*-ray examinations of the *total* digestive tract, not only of it segments, should be carried on, because of the high percentage of multiple cancers in different segments of the digestive tract.

3. The influence of multiple cancer on the blood as well as the study of the value of the phosphatase reactions in multiple cancer should be further investigated.

4. The view expressed by Boyd "that the present of one malignant tumor usually confers an immunity which prevents another from developing" and that the "carcinomatous changes in multiple polyps of the intestine occurs only in one papilloma" is not borne out by this material. In four cases of polyposis, there were multiple cancers of the large intestine; in one instance, there were three primary growths and in another five.

5. Thirteen clinically observed cases of multiple cancer were studied, of which five are living and eight are dead. Among the living cases we had two synchronous and three metachronous cases. The two synchronous cases were two and one-half years and three and one-fourth years after operation. Both are still in good health, but the five-year limit has not been reached. Also, the three metachronous cases have not reached the five-year limit. There is good reason, however, to believe that all five patients will be absolutely cured. Therefore, it can be concluded that the prognosis in multiple cancer is not altogether hopeless.

I wish to express my indebtedness to Dr. A. M. Pappenheimer and Dr. George Draper for valuable suggestions.

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TUMORS IN THE REGION OF THE CAUDA EQUINA

A REVIEW OF TWENTY-FIVE CASES

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TO a great many the differential diagnosis of low back pain with or without sciatic radiation is a daily and a very important problem. The problem calls for a systematic investigation of the many causes of the "so-called sciatic syndrome." Among these causes, particularly since the publications of Mixter and Barr,[1] the herniation of an intervertebral disc and hypertrophied ligamentum flavum has gained such prominence that other causes of sciatic pain are being pushed to the background and are failing to receive the attention they deserve. Among these less frequent, but equally important causes responsible for back pain with sciatic radiation are tumors of the cauda equina.

Our recent experiences have shown that the presenting symptoms in early cases of tumors of the cauda equina are not unlike those elicited in patients with herniated nucleus pulposis. Because of this great similarity a review of those tumors was undertaken to learn if there are any dependable criteria of differentiation. From a therapeutic point of view it is very important to distinguish between these two conditions, especially since the operative exposure of a disc is as a rule a very limited one, and a neoplasm of the cauda equina through such an exposure can readily be overlooked.

As was recently pointed out by Van Wagenen and Rossier[2] the early diagnosis of spinal cord tumors is still not too frequent. In their study of thirty-three cases of spinal cord tumors only three patients were ambulatory at the time of admission. On the average seventeen months elapsed from the time the patient first consulted a physician until the time of operation.

Even more difficult is the early diagnosis of neoplasms in the region of the cauda equina. Among the helpful diagnostic criteria with reference to early recognition of such lesions Bennett[3] has stressed spasm of the erector spinae muscles, shortening of the hamstrings, and pain upon hyperextension of the spine and extreme flexion of the legs. It is interesting that such were the early findings in Bagley's[4] unusual case of a dermoid of the cauda equina.

In Allen's[5] review of sixty-nine cases of cauda equina tumors from the National Hospital Queen's Square the first and most constant symptom was intermittent back pain with remissions varying from several months to a year. This was present in 90 per cent of the cases. Coughing, straining, or lying in the recumbent position aggravated the pain. In about 60 per cent of the cases motor disability followed sensory disturbances, and yet in 23 per cent of the entire group sensory changes were absent. The first abnormal tendon reflex changes were found in the ankle jerks. However, it is significant that in 10 per cent of the cases all reflexes were entirely normal. Spurling and Mayfield[6] found that the absence or diminution of the tendon reflexes of the lower extremities were among the earliest objective neurological findings in cauda equina neoplasms.

Inflammatory lesions of the cauda equina may easily mimic the findings of a neoplasm in this region. From a surgical point of view it is more important to determine the presence or absence of a growth in the region of the cauda equina, rather than its exact location. Elsberg and Constable[7] in a study of forty-five cases, twenty-eight of which proved to have a new growth,

found that the total protein of the spinal fluid was the most helpful diagnostic factor. In each instance in which a neoplasm was found the total protein was increased, whereas in those instances with inflammatory lesions there was no elevation of the total protein.

ANALYSIS OF CASES

This group of twenty-five patients with tumors of the cauda equina represents 18.5 per cent of the total number of spinal cord tumors in our series. While analyzing this series of cases it became quite evident that in the very early stages neoplasms in this region are unusually difficult to recognize and at times practically impossible to differentiate from a herniated intervertebral disc. On the other hand in the very advanced stages the diagnosis of a cauda equina tumor can often be made at a glance.

As the clinical syndrome, which these neoplasms produce, becomes more familiar, precise diagnostic studies of the spinal fluid will be employed earlier and more frequently. The results of such studies will inevitably lead to earlier recognition of neoplasms of the cauda equina, and treatment will be instituted long before irreversible damage to the roots has taken place.

The clinical picture of the twenty-five patients under consideration can best be appreciated if they are grouped under the following three headings:

1. Cauda Equina neoplasms with advanced neurological signs. In other words those who entered the Hospital not on their own motor power. Of these there were five patients, 20 per cent of the cases.

2. Cauda Equina neoplasms with early neurological signs. Those who at the time of admission were still able to walk with little or no assistance. These numbered sixteen patients in our series or 64 per cent of the cases.

3. Cauda Equina neoplasms with no objective neurological signs. These patients, four in number, (16 per cent) were recognized as a result of systematic laboratory studies. More specifically, the abnormal spinal fluid findings and the injection of lipiodol clearly established the presence and position of the new growth.

In our first group of five patients who were unable to enter the hospital on their own motor power, two patients had malignant neoplasms. One was an osteogenic sarcoma and the other a neuroblastoma.

The remaining three patients had benign neoplasms, two neurofibromas and one ependymoma.

The outstanding and initial symptoms in these patients was pain over the lumbosacral region. The duration of pain varied on the average from six months to one and one-half years, but in one patient the pain had persisted for almost thirty years. The pain in all these patients radiated from the lower back down one leg and then spread to include the other and was consistently accompanied by weakness of either or both legs. Urinary symptoms presented themselves from two weeks to four months before hospitalization.

Atrophy of the legs accompanied the paresis and sensory loss was confined to the sacral segments. The knee and ankle jerks were either seriously diminished, or completely absent. Urinary retention with overflow of the bladder was the rule.

In only one instance was there widening of the lumbar canal by *x*-ray. In another case there was *x*-ray evidence of destruction of the body of the third lumbar vertebra due to invasion by malignant growth.

Lumbar puncture in two cases showed xanthrochromic fluid and complete manometric block. In two patients it was necessary to inject lipiodol for the exact location of the neoplasm.

There were no operative fatalities and improvement was noted only in the three patients who had benign neoplasms. With return of power there was return of urinary control and then a better appreciation of sensation. These three patients left the hospital greatly improved and now are able to care for themselves.

An example of this group is the following case history:

On January 6, 1936, a fifty-six year old housewife was admitted to the hospital because she was no longer able to walk. The patient was in a good state of health until six months previously, when she began to have pains across the lower back. Shortly after the onset of the back pain she also noted pain in both hips, and then pain in both knees radiating down the anterior aspect of both legs to the toes. These pains were sharp and intermittent and were not influenced by coughing or straining. About this time there was also weakness noted of both legs and increasing difficulty in walking. Soon there was delay in starting urination, then urinary retention and finally overflow incontinence. For two weeks before admission these symptoms advanced rapidly so that she was no longer able to get out of bed.

Fig. 1. Lipiodol arrest at lower border of thoracic 12. Note irregular shape of "cap" outlining upper pole of neoplasm.

Examination showed a thin, emaciated, and chronically ill person with marked wasting of the muscles of the lower extremities, and a decubitus on the left heel and over the sacrum. There was some movement of the toes, otherwise the legs showed a flaccid paralysis. Sensation of pain, temperature and light touch was completely lost on both sides over skin areas of sacral two to five inclusive. In addition there was hypesthesia over the first sacral areas. Position and vibration sense were not impaired. Knee jerks, ankle jerks and lower abdominal reflexes were absent.

Fig. 2. Patient's position while standing.

Lumbar puncture failed to yield any fluid. Lipiodol was then injected through the cisterna magna and came to a complete arrest at the twelfth thoracic vertebra. (Fig. 1.)

Laminectomy disclosed a well encapsulated intra-arachnoid tumor extending from the conus to the fourth lumbar vertebra. The tumor was bluish red, vascular and friable. It filled the entire canal and was intimately attached to the roots of the cauda equina. An intracapsular removal of the tumor was done.

The postoperative course was stormy, difficult and at times very discouraging. For over a fortnight there was a septic type of fever rising to 103°F. due to a persistent cystitis and pyelonephritis. In addition there were further

complications of a decubitus over the right trochanter and over the sacrum.

Because the neoplasm showed some suspicious areas of malignancy, the patient was given a series of *x*-ray treatments. Soon the pain disappeared and her general condition began to improve. There was also slight evidence of returning sensation and at the end of two months the left leg began to move.

Six months after the operation she was transferred to Montefiore Hospital where improvement continued. After two years she was finally discharged sufficiently well to walk without assistance and with no sphincter disturbance.

Re-study of the tumor proved it to be one of the benign types of spinal cord neoplasms: an ependymoma.

Comment. It is well to note that for six months this patient's condition was not recognized. By this time she was almost completely paralyzed, had urinary retention and decubitus; indeed she was a very poor surgical risk. Fortunately, the tumor proved to be benign. Two years of hard work by several departments put this patient on her feet. Had the diagnosis been made earlier, the patient would have been in far better condition for operation, the removal of the tumor would have been much simpler, and the recovery more rapid.

In group two there were sixteen patients with early neurological signs who at the time of admission were still able to walk.

A composite of their histories and findings is as follows: Four of these patients had a definite history of trauma shortly before the onset of the symptoms. The pain radiated down one leg in three cases but the radiation was bilateral in thirteen cases. In twelve cases the pain was aggravated by coughing, sneezing or straining. Sensory complaints of coldness, numbness, or tingling were referred to one extremity in three cases and bilaterally in four cases. One patient noted progressive weakness in one leg, but five observed this symptom in both legs. Sphincteric disturbances of the urinary bladder varied in onset from two days to four months before admission in six patients. Of these, five stated they had difficulty in initiating urination; only one had urinary retention.

Motor weakness of one leg was found in seven cases, and paresis of both legs was found in five cases. Sensory defects were chiefly hypalgesia and hypesthesia, involving the sacral segments. Anesthesia over these regions was unusual. In ten cases the sensory abnormality was bilateral in distribution and in three cases it was unilateral. Abnormal reflexes of the lower extremities were not consistently present. For example, knee jerks were diminished or absent on both sides in five cases, and on one side in three cases. The ankle jerks were diminished or absent bilaterally in ten cases and unilateral in four cases. Lasègue sign was present only in two patients. In one it was bilateral and in the other patient it was only on one side. The abdominal responses were impaired bilaterally in two cases and unilaterally in two cases. Spinal tenderness over the lumbosacral region was found in seven of the sixteen patients. *X*-ray studies of the spine in this group yielded no helpful data.

The spinal fluid studies on the other hand were very helpful in establishing the diagnosis. In twelve patients the fluid was xanthochromic and of these five showed a Froin syndrome. Eight patients showed complete manometric block. In only two patients was the total protein of the spinal fluid within normal limits, in eight others it was markedly increased. One patient showed a total protein of 1,920 mg. per cent.

Laminectomy was performed in this group of patients without operative mortality.

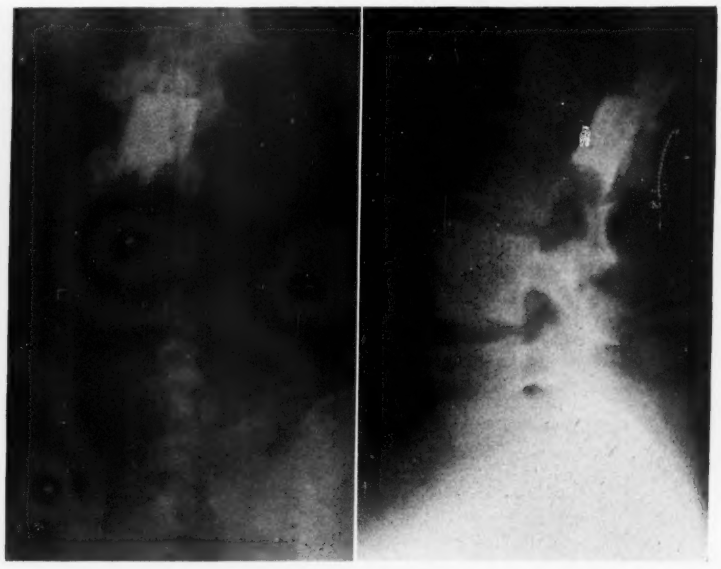
In three of the sixteen patients malignant infiltrating tumors were found and removal was necessarily incomplete. Of the remaining thirteen patients seven had neurofibromas, three ependymomas, two meningiomas and one a benign cyst.

As an example of this group the following may be briefly cited:

On Sept. 10, 1935, an eighteen year old girl was admitted to the hospital because of in-

creasing difficulty in walking. She was in very good health until two years before admission, when she began to have pain in the right thigh, which radiated down the right leg to the ankle. A year later the right leg became stiff and after three months pain and stiffness spread to the left leg. Forward bending was limited to about 15 degrees. About this time she also noted coldness and numbness in both legs. Coughing, sneezing or straining caused a tingling and tightening sensation in both lower extremities. For several months she noted that during the night both legs would suddenly jump up. The menses were irregular, but there were no urinary symptoms.

General physical examination was normal. Neurological examination showed the following abnormalities: Spasticity of both legs so that she could walk only on her toes and was unable to stand on her heels. (Fig. 2.) In addition there were adductor spasms of both legs.



A B

FIG. 3. Typical "cap" deformity of arrested lipiodol at third lumbar vertebra.

FIG. 4. Showing size of well demarkated tumor.

Hypalgesia was found to affect skin areas of sacral 3 to sacral 5 on the left, and sacral 4 and 5 on the right. Light touch and temperature were less affected over this area. Both knee jerks were absent; the right ankle jerk was sluggish and the one on the left failed to respond.

The spinal fluid was clear and colorless, showing only two cells, and no block to jugular compression. Wassermann test was negative and total protein was only 27 mg. per cent. In spite of these findings lipiodol was injected. This came to a complete arrest at the third lumbar vertebra. (Fig. 3.)

Laminectomy was performed from lumbar 3 to sacral 1 inclusive. The exposed dura was blue and tense. When the dura was opened a tumor was found filling the entire canal hiding all the roots of the cauda equina. Fortunately, this neoplasm was fairly well demarkated and, except for a few tabs adherent to some roots, it was completely removed. (Fig. 4.) Microscopic study of this tumor was subsequently reported ependymoma.

The postoperative course was uneventful, except for some urinary retention which cleared up within ten days. It is now over six years since the operation; the patient has remained well able to go to business and shows no abnormal findings.

Comment. For fifteen months this patient had typical "sciatic" pains radiating down the right leg and then it spread to the other leg. With very rare exceptions, bilateral "sciatica" is due to a growth in the region of the cauda equina. The gait and the adductor spasms were so typical of a cauda equina tumor that in spite of negative spinal fluid studies, lipiodol was injected for exact localization. The removal of this benign growth was much easier than in the previous case and recovery was more gratifying.

In our last group in which cauda equina neoplasms produced no abnormal neurological signs there were only four patients.

It is in these patients that a carefully taken history will lead to the correct diagnosis, for in this group one must depend on symptoms rather than on signs. Pain across the lower back at first radiating down one leg and then down the other was the most constant complaint. The duration of the pain varied from seven weeks to two years and was aggravated in each patient by coughing, sneezing or straining. In two patients the pain was worse in the prone position, and they found relief from pain only when in the erect posture. Periods of remission from pain were present in all the patients and in one case it lasted eighteen months.

Repeated neurological examinations failed to disclose any abnormal findings. *X*-ray studies of the lumbosacral region were normal. Nevertheless it should be remembered that there are many diseases of the spine which begin by involving the osseous structures before producing nerve irritation and compression. These, therefore, must be excluded by careful roentgen ray studies.

The information gained from lumbar puncture and spinal fluid findings were of greatest value in establishing the correct diagnosis. Since lumbar puncture is such a simple, safe and informative laboratory procedure, it is difficult to understand why there should be any hesitation about doing it. Without careful examination of the spinal fluid the study of a patient with low back pain is incomplete.

All the patients in this group, four in number, showed xanthochromic spinal fluid and in two of these there was a Froin syndrome. The total protein of the spinal fluid was 100, 86.5, 150 and 338 mg. per cent, respectively. Lipiodol injection in three patients showed an arrest of the opaque oil and clearly demonstrated the upper position of the growth. In the fourth case operation was performed without lipiodol studies.

Fig. 5. "Cap" deformity at upper border of fourth lumbar vertebra. Note the lipiodol at lower end of dural sac (sacral 1) showing block was not complete.

Briefly an example of this group is as follows:

An obese Italian housewife, aged thirty-four, was admitted on February 21, 1941, because of pain down the right leg of three years' duration. Fifteen years and again six years before admission the patient skidded down a flight of stairs striking the lower spine without any immediate ill effects. Three years before admis-

sion she began to experience spasmodic "pulling" pains in the right gluteal region which were aggravated by changes in position. *X*-ray

Fig. 6. Neurofibroma (Schwannoma) removed from fifth lumbar root.

films of the spine at this time revealed considerable arthritis. She was given injections of vaccine therapy into the sciatic nerve and after several months there was marked improvement. Eighteen months later there was an exacerbation of the pain which now began to radiate down the right thigh. *X*-ray of the lower spine at this time showed "spinal curvature and arthritis." Injections into the sciatic nerve were repeated but were ineffective. One year before admission the pain became so severe, that she had to discontinue her housework. Bending, coughing or lying down greatly intensified the pain. There were no urinary, rectal or menstrual disturbances.

The patient was unusually obese, and *x*-ray films of the gallbladder showed three calculi; otherwise the general examination was negative. Any extension of the legs caused a severe exacerbation of pain. The patient preferred to sleep in the sitting position. Repeated neurological examinations failed to show any abnormality.

Roentgen study of the spine showed productive spondylitis from the sixth to the ninth thoracic vertebrae, and also some arthritic changes in the lumbar segments, and in the sacro-iliac synchondrosis.

The spinal fluid was faintly xanthochromic and within a few minutes clotted spontaneously. The total protein was 338. mg. per cent. Lipiodol was injected and was arrested at the upper border of the fourth lumbar vertebra. (Fig. 5.)

Laminectomy disclosed an intradural tumor attached to the fifth lumbar root on the right. The growth was easily and completely removed and proved to be a neurofibroma. (Fig. 6.)

The postoperative course was uneventful and three weeks after operation she was discharged completely free of pain and to date is carrying on her household duties without any discomfort or difficulty.

Comment. In this patient the diagnosis of a cauda equina neoplasm was suspected from the symptoms. The laboratory findings confirmed these suspicions and the operation proved the diagnosis. The removal of the growth was comparatively simple and the resulting recovery prompt and complete.

SUMMARY

In reviewing our group of twenty-five cases as a whole, and keeping in mind the problem of the differential diagnosis of herniated nucleus pulposis, certain observations were made. Six patients had a history of trauma immediately preceding the onset of symptoms. There were, however, additional instances of long antecedent trauma, but these are not included. In some there was a fall and an injury to the back, while others stated that they felt something snap in the region of the lower spine during a sudden and unusual exertion. One can only speculate about the relationship of trauma which may cause a shift of the tumor to the immediate onset of symptoms. Even more difficult is an adequate explanation for the remission of symptoms which were noted in seven patients. The free interval varied from weeks to months. In six of these patients a soft type of tumor was found at operation, but in one of them the tumor was a hard neurofibroma.

The spinal fluid studies were of greatest help. In one patient in whom fluid could not be obtained a tumor completely filling

the lumbar canal was found at operation. In seventeen of the remaining twenty-four cases the spinal fluid was xanthrochromic. The finding of xanthrochromia in a protruded disc is so rare, that the question of a neoplasm should be raised immediately. Other details of the dynamics of the fluid have frequently been stressed. We have found multiple spinal punctures to be of considerable localizing value, so that some cases have been spared lipiodol injection.

The most frequent type of tumor was the neurofibroma, of which there were ten; there were four ependymomas, two meningiomas, two neuroblastomas and four miscellaneous growths.

While there was no operative mortality or death in the hospital, the patients with malignant tumors survived but a few months. The majority of the patients, even those with advanced signs at the time of admission, have done exceedingly well.

CONCLUSIONS

The early diagnosis of neoplasms in the region of the cauda equina can and should be made before the roots have suffered serious damage. A history of intermittent "sciatic" pain which fails to respond to simple nonsurgical measures, should have the benefit of complete spinal fluid studies. If there is any doubt as to the exact location of the tumor, lipiodol injection is indicated.

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AN INTERNAL FIXATION DEVICE FOR THE TREATMENT OF INTERTROCHANTERIC FRACTURES OF THE FEMUR

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FOR the past year and a half, my associates and I have treated intertrochanteric fractures of the femur by means of an internal fixation device consisting of a modified Smith-Petersen nail and a wood screw. When assembled, the nail and the screw form a 90 degree angle support. This arrangement permits early weight bearing since the screw, by passing obliquely through the femoral shaft, holds the reduced comminuted fragments firmly in place. The technic of placing the nail and the screw is relatively simple. Furthermore, the time required for insertion of both the nail and the screw is little more than that which is necessary for insertion of the nail alone.

To date, we have treated thirteen patients by this method, three men and ten women. The results have been most encouraging. All but one of the patients were able to start weight bearing early. Displacement of bony fragments could in no instance be demonstrated. Morbidity was negligible and there was only one death. The patient who died was an eighty-five year old woman. Her death, about a month after operation, was due to bronchopneumonia.

DESCRIPTION OF NAIL AND SCREW

The twice modified, three-flanged Smith-Petersen nail we use (A, Fig. 1) is made of vitallium; and is manufactured in three lengths, 3, 3¼ and 3½ inches. The first of its two modifications was devised by Johansson, and consists of a "central canal." Because of this canal, it is possible to slip the nail over a previously inserted guide wire when the nail is to be driven through the upper end of the femur. The other modification was made by the author. It consists of a hole cast at right angles through the head of the nail. (B, Fig. 1.) This right angle hole serves a twofold purpose. The first is to guide the drilling of an oblique channel through the femoral shaft. (Fig. 2.) The second is to help stabilize the screw placed into this channel. (Fig. 3.) The diameter of the right angle hole is about 13/64 of an inch, or approximately the same as that of the unthreaded shank of the screw it receives. It is important that the caliber of this right angle hole be equal to, or just barely greater than, that of the shank of the screw because there must be only the slightest amount of play when the screw is seated in the hole.

The screw, like the nail, is made of vitallium; and we have available screws 2, 2¼, and 2½ inches long. (C, Fig. 1.) The one we used at first was patterned after the common wood screw with its countersunk head, long shank, and relatively short threaded tail. (Figs. 4A, B and C.) Later, however, the screw was improved. The head was rounded, the unthreaded shank was made thicker and shorter, and the threaded tail was lengthened. Thus, in the improved screw the head has a flat base. The diameter of the unthreaded shank (approximately 13/64 of an inch) is slightly greater than the greatest diameter of the threaded tail. Also, the shortened shank does not extend beyond the inferior border of the right angle hole in the nail head. (A, Fig. 3.) Consequently, the threaded tail begins immediately below the lower border of the hole. As a result, the threads bite into the lateral as well as the medial cortex of the femoral shaft and thus

aid in stabilizing the fixation device. (Fig. 4D.)

METHOD OF TREATMENT

Preoperative Management. As soon as the patient is admitted to the hospital, measures to combat initial shock are instituted. The injured limb is steadied with sandbags until it is deemed feasible to apply traction. Traction, when applied, is maintained by adhesive plaster. Enough weight is used to prevent shortening of the extremity and to decrease pain.

As a further precaution, all patients are carefully examined by an internist in order to rule out any co-existing disease not related to the injury which might make operation inadvisable. Obviously, a patient with a grave organic disease, which has already been aggravated by the injury, should not be subjected to the added shock of operative interference. Such a patient should be kept as comfortable as possible by means of bed rest and traction, and suitable supportive measures should be instituted to improve his general condition.

When it is considered that operation can be carried out with reasonable safety, the skin over the site of the injury is prepared by shaving, cleaning with green soap and water, and application of an alcohol dressing which is renewed the following day. Thus, preparation of the operative site takes two days. The patient, before he is taken to surgery, is given the usual sedatives.

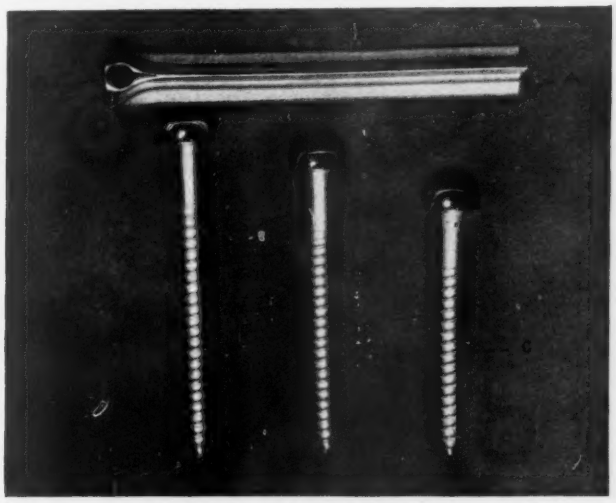


FIG. 1. A, modified three-flanged vitallium nail. Nails of three lengths—3, 3¼, and 3½ inches—are used. B, right angle hole in nail head. C, improved wood screws, 2, 2¼, and 2½ inches long. Notice rounded head with flat base, short shank, and long threaded tail of these screws. It should be stated, however, that the head is larger than is necessary. It need be only large enough to keep the screw from slipping through the right angle hole.

Operation. Spinal block or gas inhalation anesthesia may be used. Novocaine infiltration is, however, satisfactory. But whichever agent is employed, it is important that it be started before an attempt is made to reduce the fracture. It is our practice to begin the anesthetic as soon as the patient is brought to the operating room and while he is still on the stretcher. This is done to obviate the pain which the patient would otherwise have when he is moved from the stretcher.

As soon as the patient is completely relaxed he is transferred from the stretcher to a fracture table, that is, a table which has both a pelvic and a perineal rest. Such a table facilitates the taking of roentgenograms during the course of the operation.

After the patient has been placed on the fracture table, anteroposterior and lateral

roentgenograms are taken to ascertain the position of the fracture. Manipulation and traction, if necessary, are then carried out,

Fig. 2. Schematic drawing illustrating manner of drilling oblique channel in femoral shaft. Notice drill in right angle hole of nail head.

and roentgenograms are again taken. If the roentgenograms show that the fracture has been satisfactorily reduced, the reduced position is maintained either by an assistant or by the traction apparatus attached to the table, and the open operation is then carried out.

The skin incision is made on the lateral aspect of the thigh, along the axis of the femoral shaft. In order to obtain sufficient exposure of the base of the greater trochanter and the upper part of the femoral shaft, the incision should be about 4 or 5 inches long, measuring from the tip of the trochanter to about 3 to 4 inches below the trochanteric base. However, when the patient is obese, it may be necessary to extend the incision above and below the greater trochanter.

The muscles and other underlying structures are then divided until the bone is exposed. As division of these structures progresses, bleeding is controlled with catgut ties or with the electric cautery rather than with hemostats because the metal instruments would show in the roentgenograms and obscure the view.

When the bone has been exposed, a

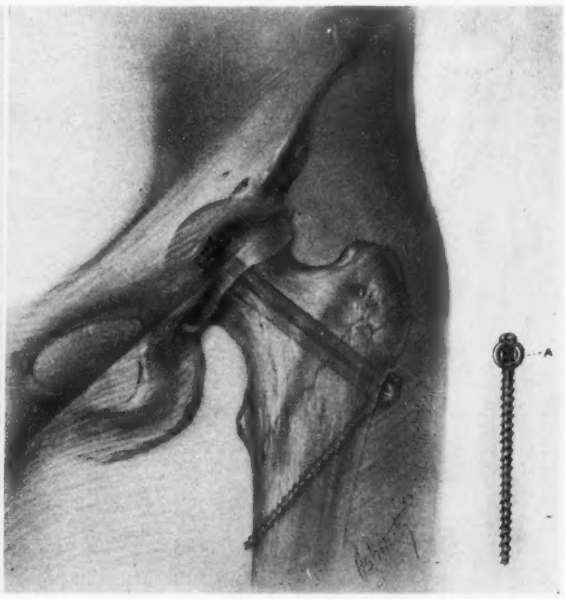
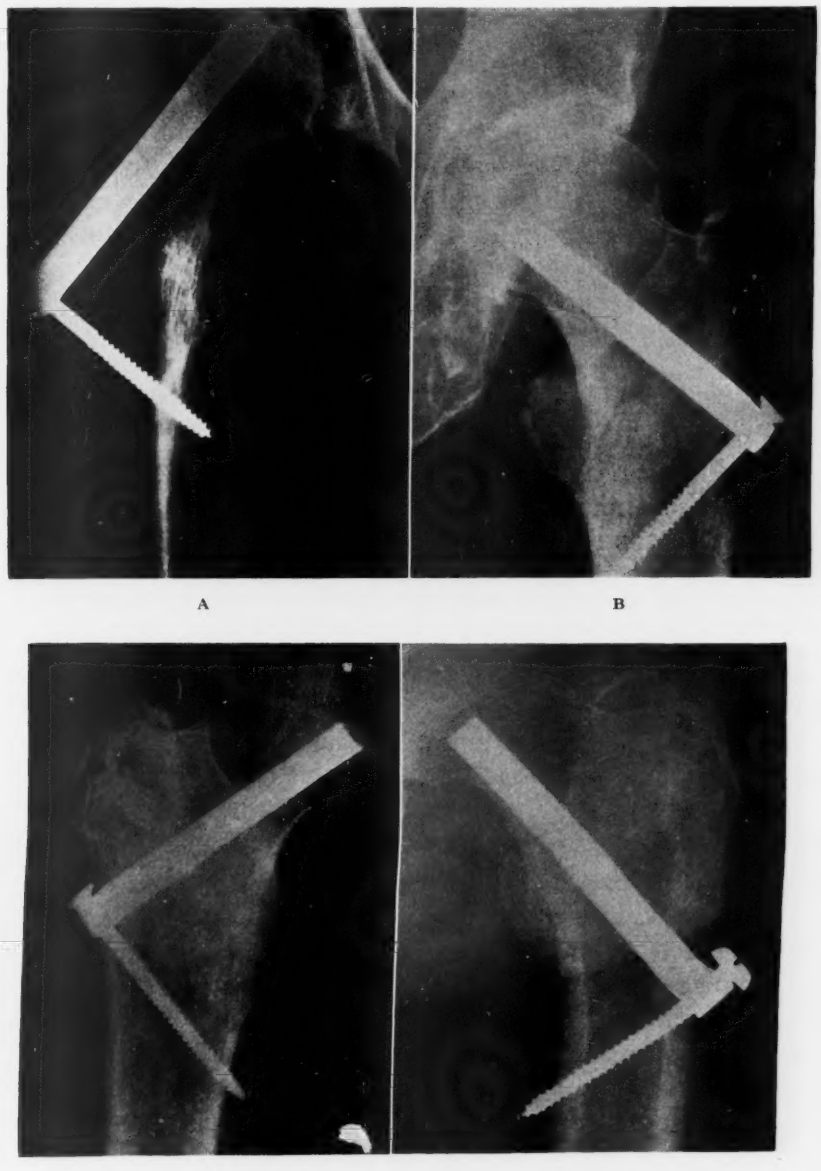


Fig. 3. Schematic drawing showing 90 degree angle support formed by proper placing of nail and screw. Notice, A, that shank of screw does not extend beyond inferior border of right angle hole and that threads begin immediately below hole.

Kirschner guide wire, started at the base of the greater trochanter, is passed through the neck and into the head of the femur. The position of the wire is checked by roentgenograms. If it has not passed through the center of the femoral neck, another wire must be inserted. The incorrectly placed wire is not removed, however, until the second wire has been passed. By leaving it in place, it serves to correct the angle at which the second wire is inserted.

As soon as roentgenograms show that the guide wire is in a satisfactory position, a nail of suitable length, attached to a hollow driving rod, is slipped over the guide wire. But before the nail is driven in, it is important to make sure that the right angle hole in the head of the nail points in the direction of the axis of the femoral shaft. If it does, driving may be started. When the nail has been driven about half way into the bone, the driving rod is unscrewed and

the guide wire is extracted. This is done to prevent the possibility of bending the wire during the driving process. After the wire has been removed, driving is resumed with the right angle hole in the head of the nail. (Fig. 2.) In this way there is less danger of deviating from the diagonal direction it is important to keep.



A B C D

Fig. 4. Roentgenograms of patients treated by this method. A, B and C, show the common wood screw originally used. D, shows the improved screw. Each film was taken after the patient had been bearing weight for several months. The screws extend a little too far beyond the medial cortex in these cases.

a mallet, and is continued until the right angle hole in the nail head is on a level with the lateral cortex of the femoral shaft.

The next step in the operation is the drilling of the oblique channel through the femoral shaft. As has already been pointed out, this is done with the drill inserted in

Stabilization of the fixation device, it has been shown, is improved because the threads of the screw bite into both the lateral and the medial cortex of the femoral shaft. In order to insure still greater stabilization, it is desirable for the screw threads to bite into the walls of the channel as well.

Hence, the bore of the channel must, as is readily apparent, be slightly smaller than the caliber of the threaded tail of the screw. We have found that a channel of proper dimensions can be made with a drill having a diameter of either 11/64 or 5/32 of an inch and a length of 5 or 5½ inches.

Drilling of the cavity in the femoral shaft is continued until the surgeon can feel that the point of the drill has just barely pierced the medial cortex. When he feels that it has, and before he removes the drill, a piece of catgut is tied to the drill immediately above the superior border of the right angle hole in the head of the nail. Thus, when the drill is removed, it is an easy matter to measure the distance between the piece of catgut and the point of the drill in order to select the screw which most nearly approximates the length of the oblique channel. Although screws that extend beyond the medial cortex of the femoral shaft will cause no damage, we prefer to have no more than the tip of the screw protrude beyond the cortex. For this reason we keep on hand screws of varying length, that is, as previously stated, 2, 2¼, and 2½ inches long. These have so far adequately filled our needs.

After a screw of suitable length has been selected, it is inserted in the right angle hole in the nail head, passed down into the oblique channel in the femoral shaft, and screwed securely in place. (Fig. 3.) Once the screw is in place, the wound is closed in layers and a dressing is applied. The dressing is held in place by means of a cotton elastic bandage. Neither a plaster cast nor traction is applied since they are not considered necessary.

Postoperative Care. Two or three days after the operation the patient is encouraged to sit up in bed. And a week postoperatively he is allowed to sit up in a wheel chair. At the end of two weeks the skin sutures are removed. The patient is then encouraged to begin weight bearing with the aid of crutches, and he is urged to continue this each day until he can get along without any assistance. Ordinarily all walking aids can be discarded after four weeks. A young and active patient may start weight bearing sooner than two weeks after the operation if for any reason he should desire to do so.

Removal of the Fixation Device. It is, of course, not necessary to remove the nail and the screw. They may, however, be removed after bony union has taken place. When this is done, the exposure need be no greater than that which is necessary for removal of only the nail.

Roentgenography. It is our practice to have both anteroposterior and lateral films taken each time any step in the operative procedure is checked by roentgenography. We believe this is extremely important because a single view often does not give accurate information with regard to the position of bony fragments or of the internal fixation device.

In taking roentgenograms during the course of the operation, the technician drops each cassette into a sterile pillow slip which is held by the surgical nurse. Cassettes protected in this manner can be held in any position by an assistant without contaminating the operative field.

Since a number of films are taken during the course of the operation, it is of the utmost importance to shorten the time required for exposing, developing, and fixing the films. We have found that satisfactory films can be obtained in a minute and a half by overexposure and underdevelopment. In other words, by this method, about one-third more exposure is used than is required for films taken in the usual manner. And the solutions used for developing and fixing the films are heated. The temperature of these solutions is kept at 72°F. It may, however, be allowed to go as high as 76°F., but it should not exceed this.

SUMMARY*

A simple internal fixation device for the treatment of intertrochanteric fractures of

* Since this article was submitted for publication, the author has performed the operation described

the femur is described. This device consists of (1) a three-flanged, vitallium nail, with a channel throughout the length of its shaft and a right angle hole in its head, and (2) a vitallium wood screw. When assembled, the nail and the screw form a 90 degree angle support which makes possible early weight bearing.

Included also is a detailed description of the relatively simple technic of inserting both the nail and the screw. The management of the patient before as well as after the operation is discussed. And a procedure for shortening the processing of roentgenograms during the course of the operation is outlined.

Thirteen patients have been treated by this method. All but one of them were able to start weight bearing, with the aid of crutches or a walker, approximately two weeks after operation and to discard all walking aids at the end of four weeks. There was no displacement of bony fragments. Morbidity was of little or no significance. Only one patient died; death in this instance occurred a month after operation as a result of bronchopneumonia.

therein on seven more patients with intertrochanteric fractures of the femur and on two patients with fractures of the femoral neck, making a total of twenty-two patients treated by this method. The results obtained in the second group of nine patients have been as satisfactory as those in the first group of thirteen patients.

An essential principle in the care of compound fractures is that no treatment of the wound itself should be allowed to interfere with correct splinting.

FALLACIES OF BONE PLATING

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WE surgeons in the United States appear to have the great weakness of being guided or almost controlled by dictums. A dictum, according to Noah Webster, is an "assertion or statement which claims to be or is authoritative." In other words, a dictum is an American method of putting something over. We have two kinds of dictums: The highly ethical dictums put out by our leading surgeons, telling us how things must be done and the plain dictum used by our firms to sell us something. Time after time an intern or young doctor will state, "never do this, always do that," and I ask him "Why?" The answer invariably is in the words of one of our latest popular tunes: "My professor done tole me." He has no real reason and probably has not enough mechanical knowledge to explain or give reasons.

Lane gave us our bone plates and they were used by many with varying success, but the plating was only an aid to reduction and the fracture still needed casting support. It did not expedite union and, most important, early return of function which could not just as well and rapidly have been obtained by simpler nonoperative methods.

In other words, the following difficulties appeared: (1) The plate was not mechanically strong enough to give absolute support. (2) The screws did not hold and were put in gently but not tightly as they might strip the threads. For this, the texture of the bone was blamed. (3) The fracture still required extensive immobilization and casting with resultant stiff joints and muscle atrophy. (4) The patient had been subjected to the risk of a major operation without expediting return of function.

About two years ago, Doctors Townsend and Gilfillan, of Los Angeles, perfected a bone plate, which from a mechanic's viewpoint, is almost perfect.

T AND G BONE PLATES

The plate is made of 18-8 stainless steel which is of great tensile strength. Structurally, it has angle iron bridge girder structure which gives it unusual strength. The screw holes are slots, so that screws can be put in at an angle if desired and so that at no time will an off-center drill hole pull the bones apart as it will do in most types of plates. The plate is ideal in transverse fractures for after the plate and screws are in place, the screws may be loosened in the distal fragment and the foot or knee bumped and so drive the fracture ends together. The screws slide in the slot and can be tightened and so give perfect end-to-end apposition.

A single plate of four or five holes is used on tibias and will sustain body weight even on oblique fractures. In the case of femurs, two plates, one nested on top of the other, are used on the lateral side, since due to the structure and mechanics of the femur, normal weight bearing gives a lateral bowing stress on the shaft of the femur. Also two nested plates, due to its structure, gives five times as much support to a femur as two single plates applied to opposite sides. The two plates together have a "leaf-spring" action.

APPLICATION OF THIS BRIDGE GIRDER

It has been proved experimentally that a screw will hold firmly in the bone if the screw is of strong material and has the proper threading.

Special Screws. The screws are made of 18-8 stainless steel, the same as the plate, but are machine threaded individually by

ERRORS IN TECHNIC CAUSING FAILURE

The drill must be No. 36 wire gauge. The drilled hole must go through both cortices.

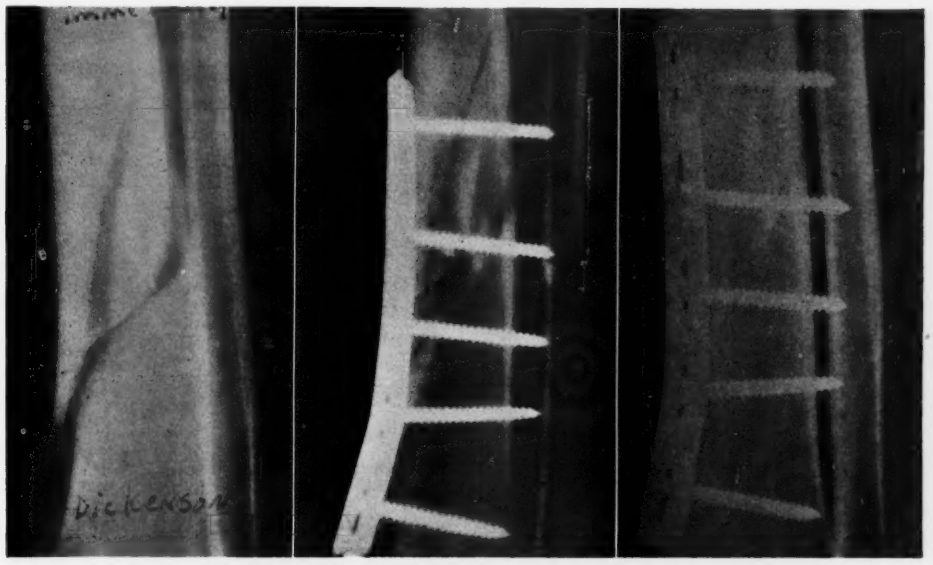

FIG. 1A. FIG. 1B. FIG. 2.

FIG. 1. CASE 1. The patient was a parachutist, twenty-two years of age. The plating was done in four hours. No cast or support was used. He was on crutches with weight bearing in fourteen days and walked without a cane or crutches in four weeks.

FIG. 2. CASE 1. Showing union in eight weeks. The patient had perfect function and returned to duty in ninety-one days.

hand and not cast. This gives maximum strength. The thread on the screw is twenty to the inch because tests have shown this thread has the maximum holding strength for bone. The screw has a "tuk tap" end so that the screw cuts its own thread as it is turned into the drilled hole.

The bone is drilled through both cortices with a No. 36 drill (about 7/64). The screw No. 6 (about 9/64) is put in and gently turned (do not bear down on the screw) and it pulls itself in cutting its own thread as it goes. It is *important* not to bear down on the screw as you would on a wood screw but turn it gently as a machinist turns a tap die. After the threads are cut through both cortices, the screw can then, and must, be tightened as tight as it can be forcibly turned. If handled like machine screws, it can be removed and a longer or shorter screw inserted. The screw must go through both cortices.

Screws must be turned in gently for if pressure is used, the "tuk tap" end acts as a reamer and the screw will be loose. The screw must go through both cortices.

Finally, all the screws must be tightened as tight as possible before closing up. The screw must not extend beyond the distal cortex as results shown in three cases in which screws projected ¼ inch prove that this does not cause electrolysis or necrolysis but, contrary to belief, nature throws dense bone out around the screw ends, thus giving, in tibias, a much larger unsightly tibia. (Fig. 4.) In fractured femurs this, of course, is desirable.

So a plate strong enough to hold and screws capable of being handled like machine screws have been devised. As a result, no cast or support is needed and patients are allowed up on crutches with light weight bearing, in the case of tibias, in two weeks, and in the case of femurs, in four weeks. No stiffened knees or ankles

and no muscle atrophy result; therefore, there is no loss of function and the patient returns to duty at an early date.

six weeks. In two months full weight bearing was allowed and almost complete repair was visible. Full union in three

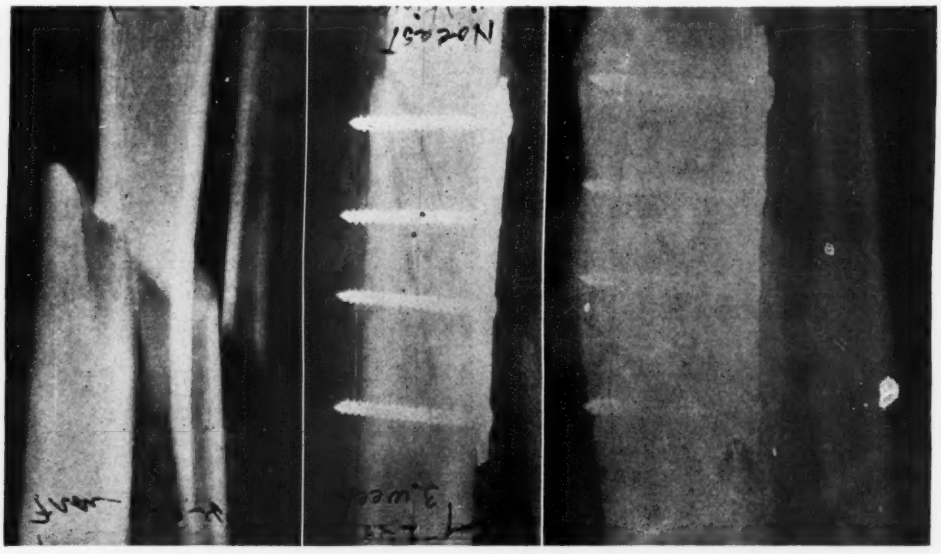

Fig. 3a. Fig. 3b. Fig. 4.

Fig. 3. Case 11. Fracture occurred on January 7, 1942, and it was plated on January 27th after arrival at hospital. No cast or support was used. Reduction picture taken in three weeks after patient had fallen twice. Note the callus. The patient was on crutches in fourteen days and was able to walk and run in four weeks without cane or crutches and with full function.

Fig. 4. Case 11. Note that too long screws were used and in four months nature had thrown bone around the end of the screws.

Failure in plating may be due to our own error in technic. We had two cases of tibia plating that required casting. In one case the screws did not go through the distal cortex. In the other case the surgeon pushed hard on the screws and stripped the threads. The screws were loose and did not give support.

We have plated fifteen cases of tibias and in fourteen cases no cast or support was used. The patients were all up on crutches in two weeks and all had marked callus and fracture obliteration in four weeks and were walking without crutches or cane. All had solid union in eight weeks. The tenth case did not have the screws through the distal cortex and so required casting for eight weeks. In all, fourteen femurs were plated, four of which were severely comminuted. All fourteen cases showed large amounts of callus and obliteration of fracture line in eight weeks and were allowed on crutches with weight bearing in months was the rule. No cast or support was used.

ANSWERS TO ARGUMENTS

Screws will not hold in bone. In my series of thirteen oblique fractures of lower tibia and fibula, no cast was applied and patients were allowed on crutches with weight bearing urged in two weeks and were walking normally with no support, no crutch or no cane in four weeks.

Callus in lower third of tibia does not appear short of two months or union short of four months. All of our ten cases had heavy callus and obliteration of fractured line in four weeks and solid union in eight weeks.

Too perfect reduction delays union. We obtained, in all our thirteen oblique fractures, almost perfect apposition and had solid union in eight weeks. We concluded that by our previous methods absolute fixation was not obtained and friction re-

sulted in fracture site causing delayed union.

Metal will cause electrolysis or necrolysis. This in our series of fifteen tibias and thirteen femurs and four ulnars plated was completely ruled out. In three cases in which screws were used that protruded ¼ inch through the bone, nature provided callus and finally bone completely around the ends of the protruding screws. (Fig. 4.) The *x*-ray department reported that in all thirty-two cases no evidence of any loosened screws or necrolysis was seen except in the one case in which screws did not go through both cortices. Our conclusion is that with the old type screw the failure to hold made the loose screw act as a foreign body and cause necrolysis.

Bone cannot be plated and left without other support. All thirty-two of our cases, both tibias and femurs, had early weight bearing and no cast or brace was used. Due to the strength of the plate and perfect holding power of the screws, perfect reduction was obtained and held. In fact, one case of oblique fracture of tibia and fibula of the lower third, the patient fell down twice in his third week after plating with no bad results physically as shown by *x*-ray. (Fig. 3.)

Bone defects due to loss of fragments in the fracture line tends to delay union. Again, I state, that this is due to the fact that we have never had complete rigid fixation. In a number of our cases with bone defects in the fracture site, the defect has closed in rapidly. The absolute fixation allows an undisturbed blood clot to organize and furnish a bridge for callus formation. (Figs. 5, 6, 7, 8 and 9.)

WHEN TO PLATE

1. Acute fractures if seen within five hours and if clean are plated immediately and have given excellent results.

2. Fractures over six hours are not plated but temporarily cast or put in traction for fourteen days before plating. After fresh tissue destruction, we know, due to our knowledge of healing process, that we first have an inflammatory stage which lasts from three to five days and then the second or reparative stage which may last through the twelfth day. All cases plated after two weeks showed extensive callus in three weeks after plating, so practically no time is lost by the two weeks delay. Under this class also comes all shock cases which should, and must, be treated palliatively.

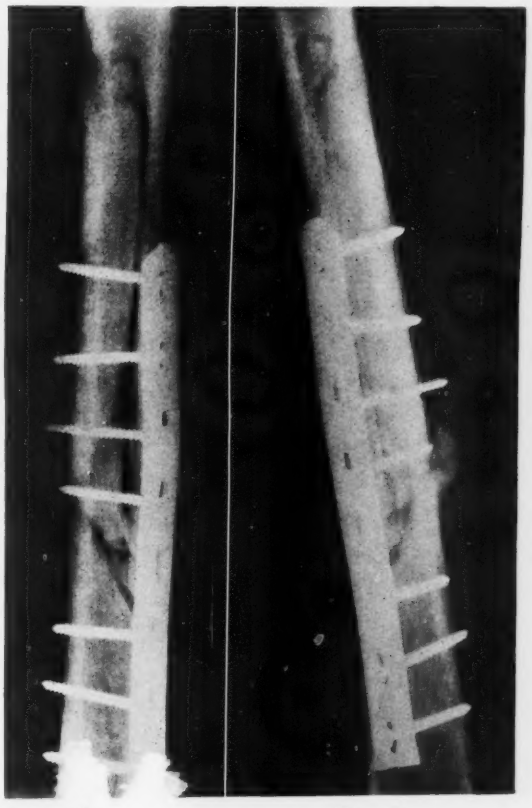

FIG. 6.

FIG. 5. [illegible] Note that third screw from the top [illegible] the plate. The two fragments [illegible] fixed with a screw and then plate applied [illegible] the top. No cast or support was used.

FIG. 6. Case [illegible]. Shows dense callus and repair in eight weeks at which time the patient was walking with a cane.

3. Compound fractures are not plated. I can see no reason or excuse for immediate plating. If, after thorough débridement, closure and temporary traction or casting, you get primary healing in two or three weeks, plating can then be done safely; and according to previous statement, none if any time is lost in final union. On the contrary, if infection persists, you have a disastrous osteomyelitis. From personal

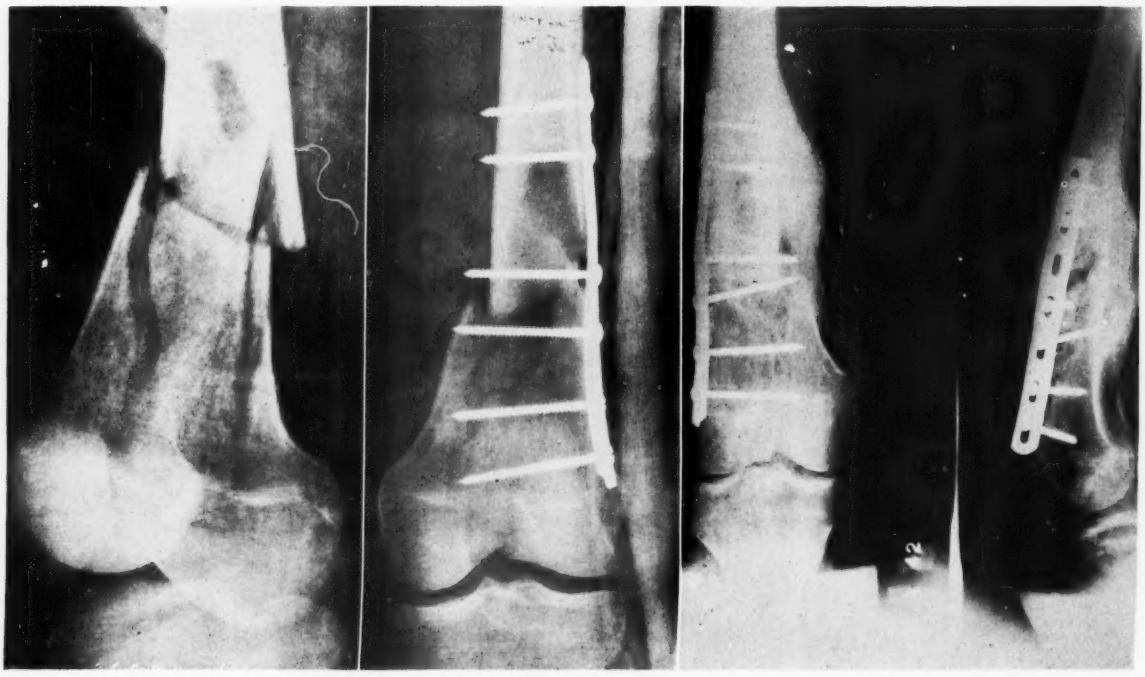

Fig. 7. Fig. 8. Fig. 9.

Fig. 7. Case iv. Comminuted rotated T fracture through condyles.

Fig. 8. Case iv. Plated two weeks later. Note bony defects, also that plate and two screws are inside capsule of knee joint. Patient was on crutches in three weeks with light supportive cast about knee. In five weeks the cast was removed. There was no fluid in the knee joint and about 22 degrees motion. Light weight bearing motion in the knee was urged.

Fig. 9. Case iv. *X*-ray at twelve weeks showed 48 degrees motion in knee joint; no fluid in knee joint. The patient was walking with a cane. Note filling in of bone defects. At four months the patient had 70 degrees of motion.

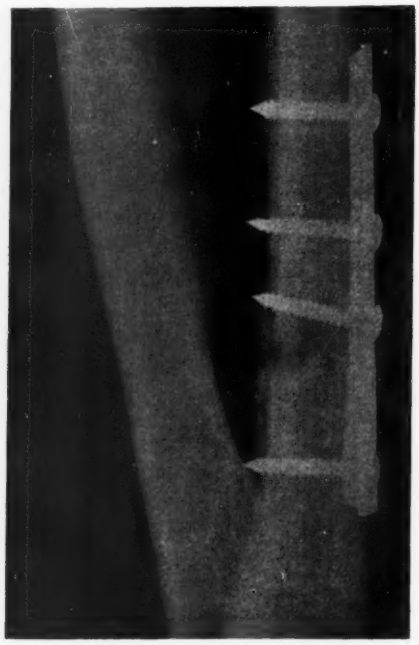

Fig. 10. Case v. Oblique ulnar at four weeks. No cast or support was used and patient had full function and use in two weeks.

observation, I have found that compound fractures treated by the two pin fixation and Orr method, after healing, do not have residual sequestration and chronic recurrent osteomyelitis. I have also noticed that all the cases of recurrent chronic osteomyelitis that came in for recurrence of infection have a history of previous plating or wiring.

In my opinion, following physiological thinking, when a bone is fractured, it splits in a natural line of cleavage that nature can handle and take care of even in the presence of infection; but if you add numerous drill holes through all the layers of the bone and through the medullary canal, it gives nature more than she can take care of and you have a resultant chronic sequestrated condition.

OPERATIVE TECHNIC

The dictum of two day preparation has been abandoned for all operative work. The operative field is shaved very lightly so as not to damage the skin. It is then washed with soap and water for ten minutes using cotton sponges only. The field is then cleansed with ether and one light coat of methiolate is conceded due to custom. A tourniquet is not used on any patient as we prefer to dry our field as we go along and not have a postoperative wound or knee bulging with a bloodclot. Towels are not used on the wound edges, first, because the towel clips make numerous puncture wounds of the skin inviting infection and, secondly, towels into wounds tend to hold all débris and blood in the operative field. The least possible amount of catgut is buried. Muscles and periosteum are not sutured. Fascia and skin are closed by silk. Close, accurate skin approximation is arrived at. We treat the skin respectfully and expect it to return the favor. No antiseptics are ever used in any wounds clean or compound. In other words, we have two dictums which we adhere to: "Cleanliness is next to Godliness" and "ain't nature grand" if given half a chance.

In eight months we have plated thirteen femurs, fifteen tibias and four ulnars with no sign of infection. Also in the last ten months we have performed 773 operations with no infection.

CONCLUSION

1. We have described an ideal structurally perfect plate and a mechanically perfect screw for boney structure.
2. Bones can be perfectly reduced and rigidly held.
3. Due to rigid fixation perfect length and alignment can be obtained and held.
4. Due to absolute fixation, early boney union is obtained at least 50 per cent earlier than any other method.
5. Due to rigid fixation, no brace or casting is needed. Ankylosis and muscle atrophy are absent.
6. Return to full duty in tibia fractures is reduced from seven months to three months, in femurs from nine months to five months.

A STUDY OF THE UTERINE CANAL BY DIRECT OBSERVATION AND UTEROGRAM

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THE study of uterine bleeding from an endocrine viewpoint has made much progress during the past few years. However, the detection of uterine polyps or submucosal myomas as a possible cause of uterine bleeding is very difficult. Probably no other organ is more susceptible to new growths, with less means of detecting them, than the uterus. *X*-ray studies or other laboratory methods are at our disposal for the diagnosis of tumors in other systems of the body. However, the submucosal myoma or polyp is usually found by the curet which is uncertain. Bimanual examination often reveals a normal sized uterus, with a smooth contour, and it is assumed that no myoma is present. Various types of therapy are given with no relief. The myoma that is definitely palpable is too often not the cause of the uterine bleeding, unless it protrudes into the uterine canal.

DIRECT OBSERVATION

During the past two years we have used two methods whereby the submucosal myomas protruding into the uterine canal, or the polyp of the uterus may be detected. A thin rubber tissue bag was attached to the end of a cystoscope and inserted into the uterine canal. The bag was then inflated with air. By this means the uterine canal could be visualized as the rubber tissue bag is transparent when moistened. This method was not used on the human, however, as it was found difficult to insert this instrument through the cervical canal and obtain good vision. The special foroblique telescope was then used, the rubber tissue bag being attached to a sheath similar to that of a peritoneoscope. With a small rubber band the bag was firmly fixed to the sheath so that there would be no risk in becoming detached in the uterine canal. A long obturator was constructed which permitted the insertion of the sheath with less difficulty.

Following the usual vaginal preparation the cervix is well dilated, and the sheath with bag attached is inserted well into the uterine canal. The obturator is then withdrawn, following which the special foroblique telescope is inserted. A small rubber washer is used over the proximal end of the telescope to prevent the escape of air when the bag is inflated.

Water or air may be instilled into the bag by means of a small syringe. A sufficient pressure in the uterine bag is usually obtained when the pressure is felt on the plunger of the syringe. Following the dilatation of the bag the telescope is then inserted as far as it will go into the uterine canal. By this means a greater part of the uterine canal may be visualized. We have used this method of observation on numerous uterine specimens and more recently on the human. Even when there is profuse uterine bleeding the pressure of the air or water media in the bag permits accurate observation of the endometrium in its natural color. This would not be possible unless some method were used, as the rubber tissue bag, to dilate the uterine canal and control bleeding. A more satisfactory instrument is being made with a smaller sheath. By this method an accurate observation of the uterine canal may be made, similar to a cystoscopic examination of the bladder.

A second method of study of the uterine canal is by the *uterogram*. We had constructed a small rubber tissue bag which

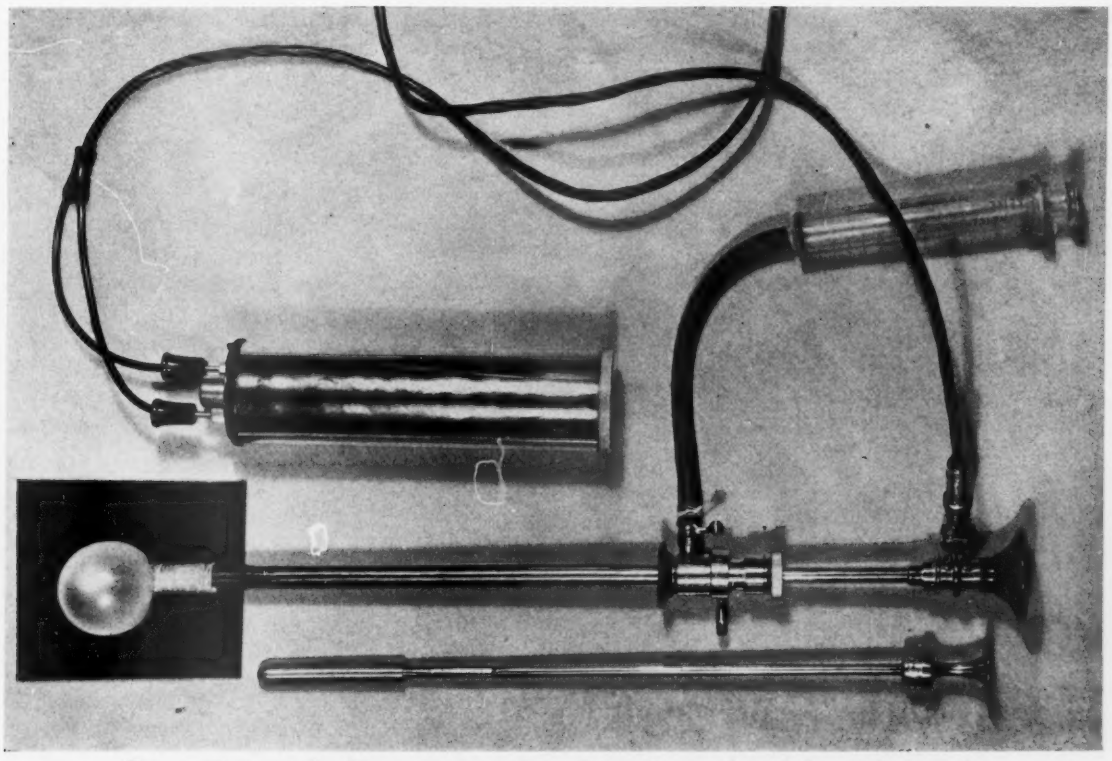


FIG. 1. Photograph of instrument used for direct observation of the uterine canal.

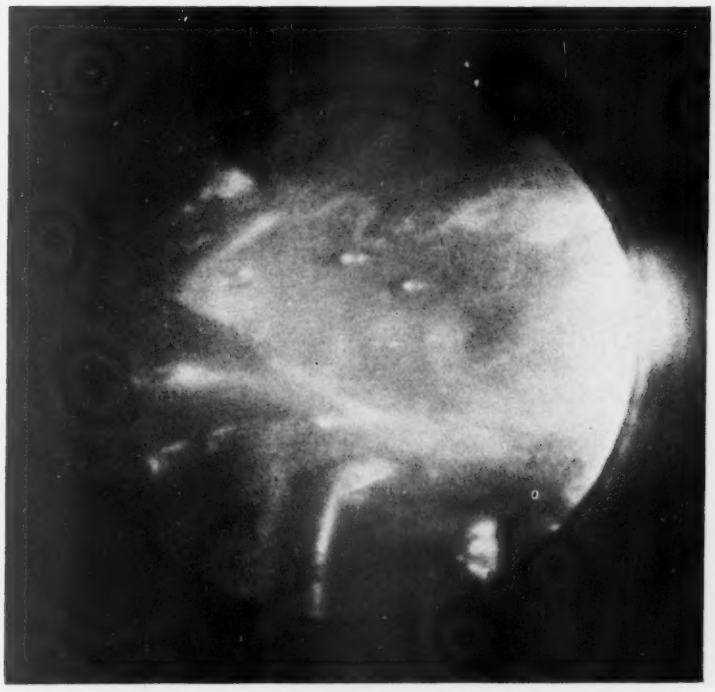


FIG. 2. Photograph of interior of fundus of uterus made through the instrument and bag.

was attached to the end of a No. 18 catheter. This was inserted into the uterus with the idea that a polyp or submucosal

Fig. 3. Normal uterine canal.

myoma protruding into the canal would depress the bag and reveal the defect by *x*-ray study. The patients were prepared similar to a preparation for dilatation and curettage of the uterus. Under gas anesthesia the cervix was well dilated, the uterus curetted, the scrapings sent to the pathologist, following which the rubber tissue bag, attached to the catheter, was inserted into the uterus. It was found that when the bag was moist it was inserted with ease by a uterine probe. Air was used as the media in the bag. To determine the position of the bag in the uterus, a small amount of air, usually 6 to 10 cc. was instilled into the bag before the patient left the operating room. If there was some difficulty in instilling the air, the bag was withdrawn and re-inserted. The size of the bag or balloon used varied with the depth of the uterine canal. This is usually ascertained by inserting a uterine probe into the canal and using a bag three-fourths the length of the depth of the uterine canal. However, we found later that there is too often an excess amount of bag inserted into the uterus rather than too small a bag. It is probably safer to use a bag half the length of the depth of the uterine canal as the cervix is not occupied by the bag.

Due to the fact that an ordinary No. 18 catheter was used, we had some difficulty with the patient expelling the bag in reaction from the anesthesia. To overcome this we usually packed strips of gauze around the catheter in the vagina to prevent expulsion of the bag when the patient reacted.

Fig. 4. Anteroposterior view of normal uterine canal in retroverted uterus.

Fig. 5. Posterior-anterior view in same patient as in Figure 2.

The following day the patient was taken to the *x*-ray room, the bag instilled with air again, and anterio-posterior, lateral *x*-rays, posterio-anterior and lateral *x*-rays over the sacroiliac region were made. By this method the entire circumference of

the bag was covered with *x*-ray studies; and if there were defects in the contour of the bag, it could be assumed that there was a possible submucosal myoma or polyp. The defect, if found, is usually fairly definite and with a wide base. Too often a small defect is seen on one contour of the balloon due possibly to an excessive amount, or wrinkling of the bag in the uterine canal. This can be overcome by releasing the air in the bag and further *x*-ray studies to determine if the defect persists. If a flat plate previous to insertion of the air into the balloon reveals much gas in the intestinal tract in the area of the uterus, it is often difficult to detect the outline of the air media from the gas in the intestinal tract. To remedy this, we later had a bag constructed with an opaque lining. This bag was used several times but it was found to be less pliable than the original bag and did not conform with the outline of the uterine canal; because of this we discarded the use of this bag. Different opaque medias were then used in the bag to outline the uterine canal. Diodrast or sodium iodide were most often used. If, with the 12.5 per cent sodium iodide, or diodrast, a definite defect is found on one contour of the balloon or bag, then a weak solution, 3 to 4 per cent of sodium iodide is injected into the bag in an attempt to determine whether the submucosal growth or polyp will displace the dye through the weaker solution as in gallstones in a gallbladder *x*-ray. However, we believe that it is probably best to use the 12.5 per cent for the original study as the weaker solution does not outline the contour very definitely. The weaker solution is, however, valuable in checking on the original examination; because if there is a defect in the

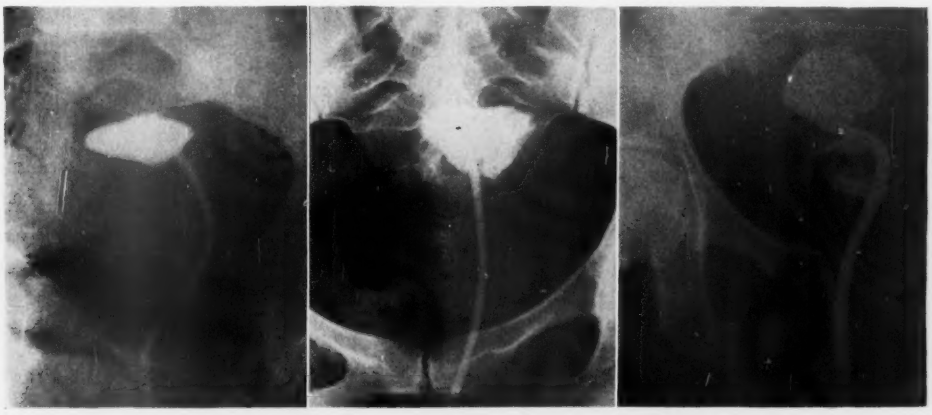


FIG. 6. FIG. 7. FIG. 8.

FIG. 6. Lateral view of retroverted uterus, normal canal but depth of triangle shortened; compared with Figure 1.

FIGS. 7 AND 8. Variations of normal canal.

FIG. 9. Lateral view of normal uterine canal.

FIG. 10. Normal uterine canal, but too large bag causing wrinkling of bag.

FIG. 11. Normal uterine canal with prominent cornu.

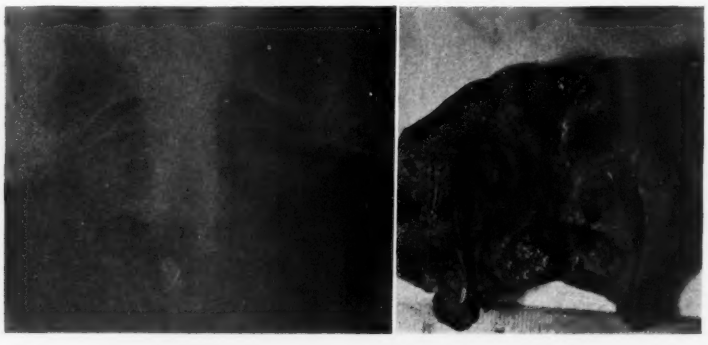
original and a displacement of the weaker dye in the second study, it is believed that there is probably a growth protruding into

Fig. 12. Large uterine canal but normal in outline.

the uterine canal. In some of our studies we instilled a small amount of sodium iodide, which was followed by an injection of air, thinking that probably the air would displace the dye around the edge of the bag and outline the contour of the uterine canal in this way. This did not prove successful as the dye was displaced by the air into one cornu or the other and did not give a clear outline.

Some of the patients, in spite of the fact that the vagina was packed very firmly with gauze, expelled the bag into the vaginal vault in the reaction from the anesthesia. To overcome this we used a small mushroom catheter to which the bag was attached by a fine silk thread. This bag was inserted by the use of the uterine probe in the eyelet of the mushroom catheter similar to insertion in the bladder. This method prevented the expulsion of the bag into the vaginal cavity, as the mushroom tip is beyond the internal os. At times small particles of air are seen in the *x*-ray study, when 12.5 per cent sodium iodide is used. Even when the bag is well aspirated and clamped before insertion of the dye there will often be seen particles of air in the bag which fail to outline the contour. This is best remedied by using the two-way mushroom catheter and instilling the dye in one opening and allowing it to return through the other until there is no air expelled. Following this, one end is clamped and then the dye inserted as in the original method. This gives a much clearer picture and is free of any air globules in the *x*-ray study.

Pentothal sodium intravenously has been used entirely recently in the place of gas anesthesia, as there is very little discomfort following the procedure and also the *x*-ray studies can be made much more quickly than when the patient is given nitrous oxide.

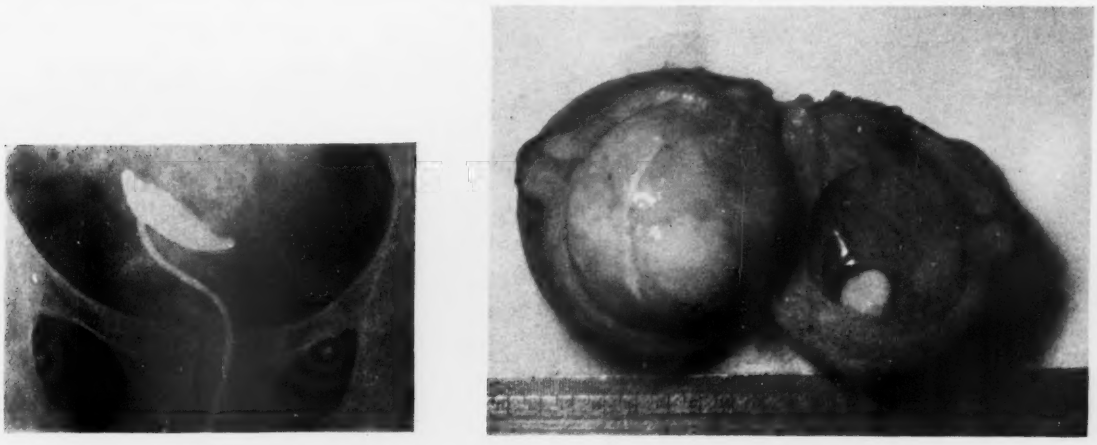


A B

Fig. 13. A, heart-shaped deformity of bag due to polyp protruding into canal; air used as media; previous curettement missed this polyp. B, uterus showing polyp in top of uterine canal.

The advantages of this procedure over the usual method, as in a salpingogram of

instilling dye into the uterine canal, are that the numerous folds of the uterine canal are pressed out and the bag can be inserted, tubes. There is a constant pressure in the uterine canal when the bag is used so that repeated *x*-ray studies from different angles

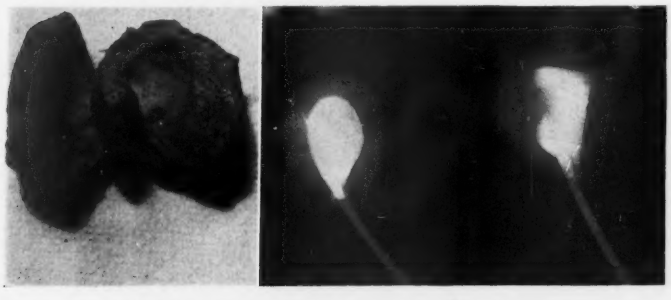


A B

FIG. 14. A, deformity of canal due to a submucous myoma. B, uterus entirely involved with submucous fibroid.

A B

FIG. 15. A, egg-cup deformity of bag due to a submucous fibroid protruding into canal. B, specimen showing the large submucous fibroid.



A B

FIG. 16. A, polyp of uterus which had caused much uterine bleeding; B, *x*-ray study of specimen with bag revealing defect on lateral view but not anteroposterior view.

the tube clamped and different angle *x*-ray studies of the uterine canal can be made which would be impossible with the ordinary method as in a salpingogram. By this method there is no leakage of the dye out of the cervical canal or the Fallopian give the same sized contour which may be compared with each other.

We have seen no ill effects of this method. When the patient complains of abdominal pain the injection of the dye is stopped. The bag has been purposely left in three

or four days, but there has been no untoward reaction more than there would be associated with ordinary dilatation of the

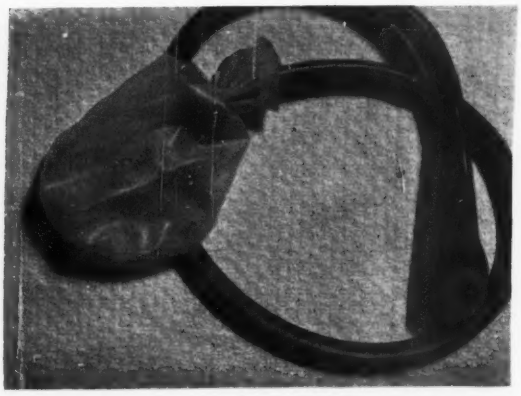


Fig. 17. Two-way mushroom catheter with bag.

cervix. The removal of the bag is very simple and without any discomfort.

We have found that there are many variations in the so-called normal uterine canal. Basically, it is of course an inverted triangle, but the proportions are often distorted to a certain extent in a normal canal. These are easily recognized after frequent use of the bag. For instance, one cornu might protrude further than the other cornu. Or in an antiflexed or retroverted uterus the length of the triangle may be shortened. However, a growth of any proportion should distort the bag so there should not be much doubt of its presence. We have several patients who have been curetted and the growth not detected, following which the bag produced a filling defect.

This method of study is also valuable in the case of uterine bleeding where a definite fibroid is palpable, as it will help determine whether the fibroid is the real cause of uterine bleeding. Too often a fibroid is palpable, and yet the cause of uterine bleeding is some endocrine disturbance. If by bimanual examination the contour of the uterus feels smooth, and following insertion of the bag no defect is found to suggest a submucosal myoma or polyp, other methods of investigation should be carried out to determine the cause of bleeding before the patient submits to surgery.

In those patients in whom there is rather profuse uterine bleeding following the *x*-ray examination with the bag, it is best to leave the bag remaining in the uterine canal to act as a hemostatic agent. This is done by inflating the bag with a small amount of air and clamping the end of the tube, allowing the air to remain in the bag, producing pressure against the walls of the uterus. This method is similar to that used in superpubic prostectomy to control bleeding postoperatively. It is a more desirable way than the method by which the uterine canal is packed with gauze. After the bag has been inflated for a period of one to two days, pressure may be released and if there is no further bleeding the bag may be removed. After a period of time following release of the air there is a tendency toward bleeding; then the bag may be re-inflated and the bleeding controlled.

Another use for the uterine bag that we have found is that of determining the presence or absence of involvement of the uterus in large abdominal masses filling the pelvis, in those patients in whom it is difficult to determine whether the mass originates from the uterus or whether it is extra-uterine. Under pentothal sodium the bag can be inserted, a small amount of dye instilled into the bag and in this way determine whether the mass is probably uterine in origin or whether it is extra-uterine.

We believe by the use of these two methods that the submucosal myoma or polyp may be more easily detected than by relying on the curet which is not reliable. Also just as important it will aid in determining whether the palpable fibroid on the serosal surface is the cause of uterine bleeding or whether it is just a coincidence and that the bleeding is referable to an endocrine disorder.

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ANESTHETIC DEATHS*

A FIVE-YEAR REPORT

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AROUSED by the reports made to it of accidental deaths in the operating room of patients under spinal anesthesia, the Medical Board of Queens General Hospital determined to investigate the entire question of anesthetic deaths and for that purpose appointed a Committee to study all such cases which had occurred since the opening of the hospital in November, 1935. This report was originally submitted in May, 1940, and covered the period up to that time from the hospital's opening date, November 18, 1935. During the two months of November and December of 1935, the first two of of the hospital's existence, there were no operating room fatalities, only seventy-five inhalation anesthetics and only six spinal anesthetics being given, fortunately with no untoward results. The original report, therefore, was later supplemented and for the purposes of this paper, omitting these first two months, covers the five-year period from January 1, 1936, to January 1, 1941.

In this study all patients, regardless of the apparent cause, who had actually died in the operating room or immediately thereafter were grouped together and then from this group were eliminated those cases in which the anesthetic obviously had played no part in the fatality. This left for further consideration a group of cases in which for one reason or another the anesthetic could not readily be freed from the suspicion that if not the actual cause of the fatality it had at least contributed materially toward it.

It is comparatively simple to incriminate an anesthetic if the patient dies on the table; it is practically impossible, however, to evaluate postoperative sequelae—pulmonary, renal or hepatic—for which the anesthetic may in reality have been the primary though insidious cause or to demonstrate a causative relationship between such sequelae and the administration of the anesthetic agent employed. Late postoperative deaths may indeed occur in which the anesthetic, though entirely escaping suspicion, is the actual causative factor. Any attempt to determine the relative safety of the various anesthetic agents, therefore, to be reliable should include the late fatalities as well as those which occur sometimes with such inexorable promptness.

TABLE 1
ANESTHETICS ADMINISTERED
(Exclusive of Local and Intravenous Anesthetics)
Total Number 19,529

Year	Inhalation	Spinal	Rectal
1936	2,573	397	0
1937	2,887	440	8
1938	3,973	561	15
1939	4,092	704	13
1940	2,748	1,091	27
Totals.....	5,273	3,193	63

Leaving entirely out of consideration, however, all possible late anesthetic deaths, this study is limited to those cases which were to all intents and purposes operating room fatalities; with the hope of indicating, at least partially, to what extent the anesthetic agent, as well as its method of administration, were responsible for the outcome.

* From Queens General Hospital, Jamaica, N. Y.

During this five-year period then, between January 1, 1936, to January 1, 1941, exclusive of locals and a few intravenous cases, 19,529 anesthetics were administered in the operating rooms of Queens General Hospital as shown in Table I.

From Table I it can be seen that of the total number of anesthetics given, 83.3 per cent were inhalation anesthetics and 16.3 per cent were spinals.

During this same period twenty-nine deaths occurred in the operating room or within such a short time after the completion of the operation as to justify investigation. These fatalities were as follows (Table II):

TABLE II
OPERATING ROOM FATALITIES
Total Number 29

Type of Anesthesia	Fatalities
None	3
Local	5
Rectal	6
Inhalation	8
Spinal	7

These twenty-nine cases were thoroughly studied with the view of determining what rôle, if any, was played by the anesthetic in connection with the fatality. Age, sex, diagnosis, operative risk, complicating pathology, operative procedure as well as the various factors directly concerned with the anesthetic itself were all included in this analysis. As a result and with the frequent additional aid of autopsy findings, it became evident that in eleven of these twenty-nine cases the outcome had not been affected by the anesthetic. These eleven cases were, therefore, rejected from further consideration. None of the cases that had received a spinal anesthetic, however, was rejected, as it was believed that each of these, regardless of circumstances, should be exposed in a full and searching examination.

There remained eighteen cases, therefore, including all of the spinal anesthesia cases, in which the anesthetic itself or its administration could not be disregarded. Table III, therefore, represents the cases in which the anesthetic was held as a possible causative factor in the fatality.

TABLE III
POSSIBLE ANESTHETIC DEATHS
Total Number 18

Case	Diagnosis	Anesthetic		
		Inhalation	Spinal	Rectal
1	Recurrent carcinoma of tonsil	..	..	x
2	Chronic appendicitis	x		
3	Toxic adenoma of thyroid	x		
4	Perforative diverticulitis	..	x	
5	Intestinal obstruction	..	x	
6	Strangulated ventral hernia Perforation of cecum	..	x	
7	Brain tumor	x		
8	Prostatic hypertrophy Diabetes	..	x	
9	Suppurative parotitis General peritonitis	x		
10	Periarteritis nodosum	x		
11	Carcinoma of floor of mouth	..	..	x
12	Gangrenous appendicitis General peritonitis Intestinal obstruction	..	x	
13	Cerebellar tumor	..	..	x
14	Bartholin cyst	x		
15	Empyema of gall bladder Common duct stone Obstructive jaundice	..	x	
16	Carcinoma of pancreas	..	x	
17	Brain tumor	..	..	x
18	Acute appendicitis	x		
Total number of cases		7	7	4

Rectal Anesthesia. Under rectal anesthesia there were four fatalities as shown in Table IV.

CASE I. This patient though considered a fair preoperative risk, was readmitted to the hospital for a ligation of the external carotid artery because of bleeding from a sloughing recurrent carcinoma of the tonsil. At the time of admission he was unable to open his mouth more than half an inch. He had had heavy radiation on previous admissions: (1) May 12, 1936, radiation 3,000 R. on each side completed; (2) June 18, 1936, evipal was given for the

insertion of gold seeds of radium, but because of rigors and cyanosis the attempt was abandoned; (3) June 24, 1936, an intratracheal anesthetic was attempted but given up because of inability to pass the tube. Under partial general anesthesia the gold seeds were finally inserted.

1938 for a cerebellar tumor at which time a cyst was removed. Under avertin, upon the opening of the dura, the patient suddenly stopped breathing. At autopsy, although a massive cerebellar cyst with internal hydrocephalus was found, the case was considered as an anesthetic death.

TABLE IV

FATALITIES UNDER RECTAL ANESTHESIA

Case	Hosp. No. Date of Death	Age	Sex	Diagnosis	Risk	Anesthesia	Operation
1	11561 12-17-36	46	M	Recurrent carcinoma of tonsil	Fair	Avertin	Ligation of external carotid
2	73583 11-18-39	56	M	Carcinoma of floor of mouth	Bad	Rectal ether	Neck dissection incision only
3	68715 2-1-40	7	M	Cerebellar tumor	Bad	Avertin	Craniotomy
4	A 12695 9-14-40	30	M	Cerebellar tumor	Fair	Avertin and local	Ventriculogram and craniotomy

Because of these previous difficulties, avertin, 90 mg. per Kg. was chosen as the anesthetic on his last admission. It was administered at 2:40 P.M., December 7, 1936. The operation was begun at 3:00 P.M., and despite the difficulties of dissection of the heavily radiated tissues, the external carotid was indentified and ligated, the operation being completed at 4:40 P.M. Throughout the operation the respirations were poor, the pulse weak and rapid. Upon the removal of the pharyngeal tube after operation, the patient ceased breathing. An effort was made to pass the Flagg intratracheal tube, but this was physically impossible. Artificial respiration, adrenalin, carbon dioxide and oxygen were all unavailing. The patient died at 5 P.M.

Case II. This patient, a problem from any anesthetic standpoint, was readmitted for a neck dissection for lymph-node metastasis from a previously fulgurated carcinoma of the floor of the mouth. On his previous admission he had almost died from pulmonary complications following inhalation anesthesia. Rectal ether was administered. A fatality occurred, however, before anything more than a skin incision could be made, it being very questionable whether this last operative effort should ever have been made.

Case III. This patient, a seven year old boy, had had a posterior craniotomy done in

Case IV. This thirty year old male patient was admitted to the Medical Service with a history of occipital headaches associated with vomiting for the preceding six months. There had also been left lumbar pain together with urinary difficulties as well as weakness of the left leg and a tendency to fall to the left. After a complete study of the case, a diagnosis of cerebellar tumor together with rheumatic heart disease and hypertension was made. Under avertin anesthesia, 60 mg. per Kg. of body weight, supplemented by local infiltration, and after a ventriculogram, which showed a massive internal hydrocephalus, an exploratory craniotomy was attempted. Before the skull flap was elevated, however, serious respiratory difficulties arose. The operation was discontinued, measures of resuscitation employed and the patient placed in the respirator. Despite all efforts, however, the patient died four hours after the operation had been begun. No autopsy was performed, the Medical Examiner's diagnosis being "brain tumor, respiratory and circulatory failure. Death under avertin and novocain anesthesia."

In these four cases, therefore, done under rectal anesthesia, while appreciating the pathology and admitting the gravity of the problem, it is difficult to exonerate the

anesthetic in an estimate of the factors leading to the fatality.

Inhalation Anesthesia. The seven fatalities occurring under inhalation anesthesia during this period are tabulated in Table v.

TABLE V

FATALITIES UNDER INHALATION ANESTHESIA

Case	Hosp. No. Date of Death	Age	Sex	Diagnosis	Risk	Anesthesia	Operation
1	33521 1-7-37	18	F	Chronic appendicitis	Good	N_2O-O_2 ethylene, ether and O_2	Uncompleted appendectomy
2	36412 12-23-42	55	M	Toxic adenoma of thyroid	Poor	Intratracheal cyclopropane	Subtotal thyroidectomy
3	67596 5-17-38	3½	M	Brain tumor	Poor	Ethylene	Decompression
4	92704 9-16-39	9	M	Periarteritis nodosum	Poor	N_2O-O_2 2–3 min.	Muscle biopsy not performed
5	99230 9-1-39	42	F	Suppurative parotitis general peritonitis	Bad	N_2O-O_2 2–3 min.	Incision and drainage of parotid
6	2031 2-26-40	44	F	Bartholin cyst	Fair	N_2O-O_2 Ether	Excision of cyst
7	79801 10-24-40	2	F	Acute appendicitis with perforation	Poor	Ethyl chloride and ether	Appendectomy

Case i. A colored girl, eighteen years of age, was admitted to the hospital on December 29, 1936, with a history of continuous pain in the right lower quadrant accompanied by vomiting on two occasions, for a period of eight days prior to admission. There was also a history of injury due to a blow in the abdomen by a younger brother. She remained in the hospital under observation for nine days, following which, after a medical consultation, with the diagnosis of chronic appendicitis, an appendectomy under general anesthesia was done. Anesthesia was begun with nitrous oxide and oxygen, ethylene and ether together with oxygen subsequently being used. There was no difficulty in induction, and for fifteen minutes the anesthetic was taken well. At the end of that time the pulse was suddenly gone and despite the usual measures for resuscitation the patient promptly died. As the result of autopsy by the Medical Examiner, the conclusion was reached that this was an ethylene-ether death during operation for chronic appendicitis.

Case ii. A male, fifty-five years of age, was admitted on the Medical Service on November 29, 1937, because of congestive heart failure, with marked cyanosis, dyspnea and tachycardia, associated with a toxic adenoma of the thyroid. Under medical care, though followed also by the Surgical Service, the man's condition gradually improved, until on December 23, 1937, twenty-five days later, it was believed both by the Medical and Surgical Services that operation should be undertaken. Under intratracheal cyclopropane anesthesia, therefore, a subtotal thyroidectomy was done, the operative time being one hour and thirty-five minutes. No operative difficulty was encountered. There was no hemorrhage, no embarrassment of respiration, no appreciable change in the pulse rate or blood pressure throughout the entire operative procedure. Upon the completion of the operation, however, during the application of the dressing, the patient suddenly died, and though an autopsy was held there were no findings to explain the result. The operative risk in this case from the earliest observation was known to be great, more, however, due to the cardiac decompensation than to the thyrotoxicosis itself. If there was too much surgery, there was at least no clinical evidence during operation to indicate the need for a multiple-stage procedure. Who can deny, however, that the cyclopropane, itself, through its depressant cardiac effect may have been the real cause of this man's death? Perhaps local anesthesia would have been a wiser choice.

Case iii. A male child of three and a half years of age, in the hospital for eight days, was given ethylene in order that a decompression might be done for a brain tumor. The opera-

tion, however, was not completed as the child died from respiratory paralysis during anesthesia. No autopsy was performed though the cause of death was given as "brain tumor; respiratory paralysis due to anesthesia."

Case iv. A boy of nine was under observation on the Pediatric Service for three months. He had had frequent attacks of asthmatic bronchitis for the past five years and was also suffering from rheumatic heart disease. A muscle biopsy was requested but never obtained as the child died two to three minutes after the induction of nitrous oxide and oxygen anesthesia given for the purpose. It was obvious from the pathology found at autopsy that death was imminent even without the anesthetic as a precipitating cause. With generalized vascular disease, hypertrophy and dilatation of both ventricles, extensive necrosis and hemorrhage of the myocardium and papillary muscles, hemorrhagic and fibrinous pericarditis with effusion, and other findings of serious disease, it is obvious that if the true status of this patient had been appreciated, and if surgery had then been undertaken, local anesthesia would have been used. The pathology was adequate, the anesthetic merely a precipitating cause for this patient's death.

Case v. A female of forty-two, was admitted to the hospital with a suppurative parotitis and generalized peritonitis, having been operated upon elsewhere for gangrenous appendicitis. She was critically ill on admission, obese, toxic, with a draining abdominal wound, a temperature of 103°F. and a pulse of 120. A suppurative parotitis with extensive cellulitis was present. After four days in the hospital during which she received radiation therapy for her parotitis, an incision and drainage of the parotid were determined upon but two to three minutes after the induction of gas and oxygen anesthesia, with cyanosis and poor pulse, despite prompt efforts at resuscitation, the patient died. Though no autopsy was performed, the case was considered as a possible anesthetic death.

Case vi. A markedly obese negress, with exertional dyspnea, rheumatic heart disease and essential hypertension with a blood pressure of 160/90, was admitted on the Gynecological Service on February 6, 1940, for the removal of a Bartholin cyst. She was seen by the Medical Service and after twenty days in the hospital was considered by them as a fair operative risk. During the induction of a gas-oxygen-ether anesthetic, the patient stopped breathing, but upon the introduction of an airway the condition improved. Ten minutes after the operation was started the anesthetic was discontinued temporarily because of the presence of a pinkish, frothy fluid exuding from the mouth. The patient's condition throughout was poor. Sixty minutes after induction of anesthesia she died, postmortem examination revealing rheumatic valvulitis, myocarditis, chronic cholecystitis with cholelithiasis and hypertrophy of the uterus. The case was considered an anesthetic death.

Case vii. This two-year old child admitted with a diagnosis of acute appendicitis with perforation, was prepared for operation, taken to the operating room and without the order of the resident, as the attending had not yet arrived, a general anesthetic was started. After ten minutes, the situation then being discovered, the anesthetic was discontinued. Twenty minutes later the anesthetic was resumed and the operation begun. An appendectomy was done, but before the completion of the operation, the patient ceased breathing, and despite all efforts at resuscitation, expired. Anesthesia in a case of acute appendicitis with peritonitis was given as the cause of death.

These deaths under inhalation anesthesia were not anticipated and came as a distinct shock. Most of these patients had been under prolonged observation and only later were subjected to surgery without the fear or expectation of an immediate mortality. Hidden pathology in marked degree was present in only one case, and in the others, no adequate cause other than the anesthetic could be found to explain the outcome. Inhalation anesthesia as well as all other types, has its dangers and along with all others demands constant, alert watchfulness in its administration.

Spinal Anesthesia. Under spinal anesthesia the following fatalities occurred, as shown in Table vi.

Real problems in anesthesia as well as in surgery are often met with in the small hours of the night when urgent cases are brought to the hospital for emergency operations. Some of these cases present many

difficulties, and the chances for successful surgery, if undertaken at all, frequently offer but meager encouragement. With surgery decided upon, however, the problem of anesthesia is next immediately encountered and despite earnest efforts sometimes fails of satisfactory solution.

TABLE VI

FATALITIES UNDER SPINAL ANESTHESIA

Case	Hosp. No. Date of Death	Age	Sex	Diagnosis	Risk	Anesthesia	Operation
1	59341 1-14-38	40	F	Perforative diverticulitis	Bad	Pontocain 18 mg.	Laporotomy
2	50256 1-28-38	50	M	Intestinal obstruction	Poor	Pontocain 20 mg.	Laporotomy
3	63009 3-16-38	45	F	Strangulated ventral hernia. Perforation of cecum	Bad	Pontocain 20 mg.	Laporotomy
4	90252 4-17-39	83	M	Prostatic hypertrophy. diabetes	Bad	Novocain 120 mg.	Suprapubic cystotomy. Bilateral vasectomy
5	A-4060 12-1-39	54	M	Gangrenous appendicitis. Generalized peritonitis. Intestinal obstruction	Fair	Pontocain 20 mg.	Appendectomy
6	A-8534 2-29-40	56	M	Empyema of gall bladder. Obstructive jaundice common duct stone	Poor	Pontocain 18 mg.	No operation
7	73749 3-19-40	40	M	Carcinoma of pancreas	Bad	Pontocain 20 mg.	Cholecystojejunostomy uncompleted

Case 1. The first of the patients to die under spinal anesthesia was admitted at 1:10 A.M., on January 14, 1938. The patient was a white female, forty years of age, desperately sick on admission, cyanotic, with severe abdominal pain, marked abdominal distention and tenderness, especially in the right upper quadrant. There was generalized rigidity and on auscultation a silent abdomen was found. This patient was first admitted to the Gynecological Service under the suspicion that she had a twisted ovarian cyst. This diagnosis not being substantiated, however, the patient was promptly transferred to the Surgical Service, meantime receiving intravenous glucose and other therapy calculated to improve the operative risk which was admittedly bad. The upper abdominal pain and tenderness were apparently confusing for with the mistaken diagnosis of perforated ulcer the patient was prepared for operation. Pontocain, 18 mg., was given, the patient being in slight Trendelenburg position, and operation begun. On opening the abdomen a diffuse peritonitis was found, but before any perforation could be located the patient collapsed and died. The abdomen was then closed. Autopsy in this case showed a perforative diverticulitis of the lower sigmoid with general peritonitis. There was a generalized diverticulosis, congestive edema of the lungs, fatty infiltration of the liver and cardiac hypertrophy and dilatation. The case was considered by the pathologists as a spinal death, "desperate" pathological condition being present.

In retrospect and at noon-day this patient's only chance probably lay in conservative therapy and absolute, surgical non-intervention. Pontocain, given in Trendelenburg position is a dangerous drug, and doubtless caused this patient's death, though it is doubtful, with the pathological condition present, if operation under any form of anesthesia would have resulted differently. Admitting the difficulties, was it not a defect in surgical judgment in operating at all rather than an incrimination of an anesthetic agent, even though not employed with the most approved technic?

Case II. A male, fifty years of age, in the hospital for two days with a partial intestinal obstruction, was likewise a spinal anesthetic death in the presence of extensive pathological disturbance. With face florid, semidyspneic, with abdomen markedly distended, a blood pressure of 164/110, with 3 plus albumin and 2 plus casts on urinalysis, the patient was considered a poor operative risk. He had had a previous laporotomy. After preliminary therapy, he was given pontocain, 20 mg., but collapsed shortly after the incision was made and died despite all efforts at resuscitation. At operation, however, an opening in the omentum was found, through which, though spontaneously reduced under the spinal anesthetic, four inches of ileum had apparently herniated. Autopsy showed extensive coronary sclerosis with myocardial fibrosis, the cardiac hypertrophy of hypertensive heart disease, atherosclerosis of the aorta, general arteriosclerosis, marked pulmonary congestion and edema and renal congestion. Cardiac failure in a patient subjected to spinal anesthesia for the performance of an exploratory laporotomy was given as the cause of death.

Case III. A female of forty-five was in the hospital for seven hours with the diagnosis of acute appendicitis and a possible strangulated unbilical hernia. On admission she was acutely ill, toxic, obese, with a huge umbilical hernia, the "size of a watermelon." Blood pressure was 160/80, urinalysis showed albumin 2 plus, glucose 2 plus, and her blood count 21,800 with 86 per cent polymorphonuclears. She was put on the critical list before operation. At operation, under 20 mg. of pontocain, only an abdominal incision could be made and although along with other measures, the resuscitator was used for forty-five minutes, death followed. At autopsy the umbilical hernia was found to be strangulated and a perforation of the cecum, with a localized peritonitis, giving rise to the symptoms suggestive of acute appendicitis, was likewise found. This obese patient also had a paralytic ileus, a cholelithiasis with pancreatic changes, myocardial changes and a nephrosclerosis. "Strangulated ventral hernia with perforation of the cecum in an obese patient under spinal anesthesia" was given here as the cause of death.

Case IV. An old man of eighty-three entered the hospital with urinary retention of one day's duration. With prostatic hypertrophy, myocardial fibrosis and diabetes, he remained on the Urological Service under medical supervision for eight days until, although he was considered a bad operative risk, it was considered advisable to do a suprapubic cystotomy and bilateral vasectomy. This was done under 120 mg. of novocain injected intraspinally. The operating time was forty minutes, the blood pressure ranging from 126/80 to 140/86, and pulse averaging 140 throughout. Toward the close of the operation he complained of pain in the chest. Dressings were applied, he was placed on a carriage and wheeled into the hall on his way to the ward. He suddenly became cyanosed and died despite carbon dioxide and oxygen, cardiac and respiratory stimulation. No autopsy was held, the cause of death being given as coronary occlusion.

Case V. A male of fifty-four, was operated upon under 20 mg. of pontocain intraspinally with the diagnosis of intestinal obstruction, which, in the terminal ileum, was found subsequently at autopsy. The onset of his illness ocurred six days prior to admission. On entering the hospital he was found to be toxic, with a blood pressure of 150/90, with his abdomen markedly distended and tympanitic throughout. There were 3 plus sugar and a trace of albumin in his urine, and a blood count showed 12,000 white cells with 92 per cent polymorphonuclears. There was some question as to whether or not he had a gangrenous appendicitis with peritonitis. Rectal examination was negative and a scout film followed by a barium enema, ruling out malignancy of the colon, confirmed the diagnosis of small gut obstruction. Considered a fair risk, though with judicious preoperative care, he was operated upon, an appendectomy with drainage being done for a gangrenous appendicitis and generalized peritonitis. The operation was completed despite respiratory collapse which occurred during the operative procedure. In the efforts to facilitate respiration, two teeth were dislodged, though recovered. In addition to this, however, the rubber cover of a tongue forceps was lost and despite laryngoscopic examination was not found. Respiratory paralysis persisted and the patient sank into deep coma. In addition to the usual measures he was placed in the respirator, never regaining consciousness, and died sixteen hours and ten

minutes after the administration of the anesthetic.

At autopsy in addition to a ruptured diverticulum of the appendix with a diffuse spreading peritonitis, an intestinal obstruction was found in the terminal ileum. There were also cardiac hypertrophy, coronary sclerosis, bronchiectasis, and cerebral congestion, and in the right main bronchus was found the foreign body. The cause of death was given as "gangrenous appendix with obstruction of terminal ileum, ruptured diverticulum of the appendix, spreading peritonitis."

This case, despite the extensive pathological disturbances and the complications incident to the efforts toward resuscitation, was doubtless a spinal anesthetic death with respiratory paralysis and cerebral anoxemia, and might perhaps have been avoided by a different technique in the administration of the anesthetic.

Case vi. A male of fifty-six, with the onset of his illness three to four weeks before admission, entered the hospital with a diagnosis of empyema of the gallbladder and obstructive jaundice. He had had a hypertension, though his blood pressure on admission was only 140/90. Acutely ill, however, with fever, chills, a tender mass in the right upper quadrant, abdominal distention, emphysema and rales at both bases, together with a leucocytosis of 21,000, polymorphonuclears 87 per cent, and 3 plus albumin and bile in the urine, he was rightly regarded as a poor operative risk. For nine days he remained in the hospital under observation, under the conservative therapy advocated by the Medical Service. At the end of that time operation was decided upon. Twenty minutes after the injection of 18 mg. of pontocain, however, the patient went into respiratory failure and coma. Operation was withheld. He was brought back to the ward and placed in the respirator. His temperature, however, rose to 109°F. and he died four hours later.

Autopsy here revealed Laennec's cirrhosis of the liver (finely nodular), splenomegaly (portal hypertension), ascites, tracheobronchitis, myocardial hypertrophy, chronic cholecystitis with ulceration and empyema of the gallbladder. The spinal anesthetic was given as the cause of death but surely the pathological condition was contributing.

Case vii. This is a case of carcinoma of the head of the pancreas in a forty-year old male. A year and a half earlier he had been a patient at the hospital, with ascites, dependent edema, and dilatation of both ventricles. This, however, had cleared up and he had been discharged as a case of rheumatic heart disease with ascites of unknown cause. The onset of his last illness began three weeks before his second admission with gradually increasing jaundice. On admission his jaundice was marked, with an icteric index of 140, his liver greatly enlarged, two fingers below the umbilicus, and following a thorough work-up with preoperative preparation on the Medical Service, which included transfusion, vitamin K, bile salts, etc., he was transferred thirty-five days later to the Surgical Service for laparotomy. Pontocain was again chosen as the anesthetic agent, 20 mg. being used. The operation was begun, a carcinoma of the head of the pancreas found and cholecystojejunostomy almost finished when the patient went into respiratory failure and died forty-eight minutes after the anesthetic was given. Autopsy findings included carcinoma of the pancreas with metastasis to the periportal lymph-nodes, invasion with stenosis of the common duct, jaundice, postoperative cholecystojejunostomy (incomplete), perforation of the gallbladder (agonal?). Cause of death, "Death under anesthesia, carcinoma of the head of the pancreas."

Most of the interest in this whole question of anesthetic deaths seems usually to center only upon those patients who die under spinal anesthesia. Deaths under inhalation anesthesia attract much less attention. This is so even when the latter are elective or when the pathological state is comparatively simple and scarcely adequate in itself otherwise to cause death. In the cases under discussion as many patients had died under inhalation anesthesia as under spinal. Of the former, moreover, only one was operated upon as an emergency and in the majority the pathological status was comparatively uncomplicated. Of the seven patients dying under spinal anesthesia four were definite

emergencies, practically all were desperate cases, admittedly bad risks, and in all the pathological condition was diverse, extensive and competent in itself to result in a fatality unless corrected by successful surgical intervention. Nevertheless despite these facts, it was the spinal deaths rather than the others that had prompted the investigation and that there had actually been an appreciable number of deaths under inhalation anesthesia as well came as a complete surprise to the professional staff.

The present series of 3,193 spinal anesthetic cases covers many cholecystectomies, gastrectomies, perforated ulcers, intestinal resections, abdominoperineal resections, amputations and other major procedures. Even in such a series as this, however, the occurrence of seven fatalities is by no means to be minimized. It is not to be minimized even though the fatalities arose among patients as desperately sick as those here presented. To minimize such an occurrence is to accept what might appear to be the inevitable and to inhibit any effort to ferret out errors and to try to correct them. This investigation uncovered what we believed to be errors; it has resulted in the formulation of different standards and seems fortunately to have been followed by a lowered incidence of unfavorable results.

The question may well be asked, "Why was spinal anesthesia used at all in these seven cases and why was it preferred to general anesthesia?" The question of the choice of an anesthetic is the first one to be answered when the decision to operate on an urgent case has once been reached, and it is at all times a difficult question. The safety of the patient is, of course, the paramount consideration; but if that safety is dependent upon the successful accomplishment of a surgical procedure, the anesthetic chosen must first of all make the operation itself possible, with a minimum of surgical handicaps, and at the same time provide the maximum amount of safety commensurate with the surgical difficulties to be overcome. It must provide this safety moreover not only during the operation itself but during the postoperative period as well, when complications attributable to the anesthetic might well vitiate the good results otherwise achieved. It is because it is the studied opinion, based on the experience of most of those on the Surgical Service at Queens General Hospital, that spinal anesthesia best meets these requirements, that it was selected in these cases, as well as in the many others in which the outcome was less tragic.

Spinal anesthesia must, however, be properly given. It must not be given by the tyro. There must be due regard to premedication, to the anesthetic agent itself, to dosage, to the position of the patient on the table at the time of injection and subsequently throughout the operation, to the desired level of anesthesia and to all the other technical points requisite to its successful employment.

Regarding premedication the methods advocated by so many writers on spinal anesthesia are usually followed, the fact being recognized, however, that oversedation is not desirable, and in the aged or debilitated must be strictly avoided. Scopolamin, while ordinarily so valuable, is a dangerous drug in such patients and is not used. The purpose is to meet individual needs and to avoid the bad results which come from the routine use of powerful drugs.

Novocain, pontocain-glucose, and nupercain (Jones Solution—1:1500) are the anesthetic agents regularly employed. The general policy of the Surgical Service in connection with spinal anesthesia is to employ novocain as the anesthetic agent only in the more robust patients who are scheduled for lower abdominal operations of short duration. Relatively small dosage is employed in the hope of avoiding serious falls in blood pressure, even though these may be well tolerated by the type of patient for whom this agent is selected. It is practically impossible, however, when using novocain or any other isobaric solution, to limit sharply the level of anesthesia

obtained or to predict accurately what that level is likely to be. In the type of patient for whom it is employed, however, and avoiding excessive dosage, this fact is of relatively minor importance.

Pontocain-glucose and nupercain (Jones Solution—1:1500) have characteristics in their effects as spinal anesthetic agents, which sharply differentiate them from novocain. Through these effects they offer great advantages over novocain but at the same time and because of these very effects, can be counted upon to cause fatalities if improperly used. These characteristics are: (1) Their ability to produce prolonged anesthesia, and (2) their ability to flow up or down the spinal canal in accordance with the position of the patient on the operating table. Pontocain-glucose being hyperbaric or heavier than spinal fluid flows downward; nupercain (Jones Solution—1:1500), hypobaric or lighter than spinal fluid, flows upward. This fact is of vital importance, for if these drugs with their profound and prolonged anesthetic effects are allowed to invade the upper levels of the cord, disaster can scarcely be avoided.

With these facts clearly in mind, however, and with scrupulous attention to technic, sharply demarcated upper levels of anesthesia can be obtained, upper abdominal operations of considerable duration can be performed, and at the same time with the uppermost levels of the cord kept comparatively free from the anesthetic agent, extreme falls in blood pressure are largely avoided. In those patients who, because of an impaired cardiovascular status, are not able to withstand the effects of sudden and extensive falls in pressure, such an advantage is obvious.

When spinal anesthesia is indicated pontocain-glucose is the desirable agent in most upper abdominal operations. In still more prolonged operations, however, such as gastrectomies, extensive intestinal resections, or in abdominoperineal resections, or in cases requiring the Trendelenburg position, nupercain (Jones Solution—1:1500) is the agent of choice.

Continuous or fractional spinal anesthesia has not been taken up at Queens General Hospital although we believe that it is close to the ideal for this type of anesthesia. Dislodgment of the needle, even though slight, sometimes, however, occurs. If this takes place after a planned operation of considerable length has been begun and further injections of the anesthetic solution become impossible, one may be faced by the necessity of forfeiting altogether the advantages of spinal anesthesia in a case, too, that especially requires it.

In six of the seven cases here presented, pontocain was the drug employed as the anesthetic agent. The study of these cases, however, brought out three important points:

1. *Dosage.* No attempt was made apparently to employ minimal dosage and unnecessarily large amounts of the drug were not uncommonly used. There seems to be a tendency in "ampoule medication" to inject the entire contents of the ampoule whenever the use of its contained drug is indicated. There can be nothing but condemnation for such a practice and the employment of 20 mg. or even 18 mg. of pontocain in case after case of spinal anesthesia is an indication of the fact that those who so employ it are unaware of the possibilities which the use of lower amounts offers.

2. *Position of the Patient on the Table.* In only one case was the position of the patient on the table mentioned in the record, and in that case the position chosen was a dangerous one for the drug employed. The taking of blood pressure, the securing of hands, and the draping of patients must all wait upon the anesthetist who, after his spinal injection, is intent upon determining and controlling the level of anesthesia produced. Not until he is satisfied and the final tilting of the table completed should these measures be begun. Slight Trendelenburg position with the

head well elevated for pontocain and slight Trendelenburg position with the head down for nupercain, as minutely described by other writers, should be assured at the time of injection, and subsequent necessary and prompt changes in position should be carefully carried out in the same way.

3. *The Use of Pontocain Alone, as a Spinal Anesthetic Agent, without Admixture with Glucose.* In all of these six fatal cases under pontocain spinal anesthesia, the drug had been used alone. With all its advantages, pontocain by itself, we believe, is a dangerous drug. Isobaric, of approximately the same specific gravity as spinal fluid, its diffusion within the subthecal space cannot be predicted nor checked, and its prolonged anesthetic effect, wrongly applied, may prove disastrous. It should, we are convinced, be used only with glucose, mixed with 2 to 3 cc. of a 10 per cent glucose solution, "weighted" with it, so that when ready for injection it is a definitely hyperbaric solution. With meticulous attention to the position of the patient on the table both at the time of injection and subsequently during operation, and with proper dosage, much can then be done to limit the area of anesthesia to the level required by the operative procedure. In none of these cases had this been done, as the dangers of using pontocain or any other agent in isobaric solution were not at that time fully appreciated nor was the fact understood that by employing under the appropriate technic only definitely hyperbaric solutions such as pontocain-glucose, or definitely hypobaric solutions such as nupercain (Jones Solution—1:1500) much of this danger can be avoided.

As soon as the above facts became known through the investigation carried out by the Medical Board's committee, means were taken to stress the dangers in all types of anesthesia. The staff became "anesthesia conscious." Proper technic in spinal anesthesia was emphasized and as far as pontocain is concerned, it was never again given without admixture with glucose. The original report of the committee had covered a period of four and a half years. It was rather encouraging to note then, that after these new regulations had been put into effect, and the report subsequently amplified so as to cover a five-year period, no further fatalities under spinal anesthesia occurred during the final six months of this period.

The statement is often made that no surgeon should give a spinal anesthetic and then proceed to operate leaving to a nurse anesthetist or someone else, perhaps inadequately trained, the responsibility of carrying his patient through the period of anesthesia. With this statement we are much in sympathy. Too, there should be no cessation in our efforts to advocate and provide for the employment only of skilled anesthetists for the administration of all types of anesthesia, putting squarely upon them the responsibility in this field which is rightfully theirs.

We cannot escape the fact, however, that to secure the services of such men in many of our hospitals, despite earnest efforts, appears at times to be practically impossible. The advantages to be derived from the use of spinal anesthesia in many difficult surgical problems, however, are such that one is scarcely willing completely to forego them, leaving to others more fortunately situated the exclusive benefits of this form of anesthesia. Until the ideal set-up can be attained, it seems fair to assume that with unremitting emphasis upon the dangers of spinal anesthesia, the need for proper selection of spinal anesthetic agents, the niceties of administrative technic and the necessity for prompt detection of danger signals as well as the energetic application of indicated therapy, that its continued use is justified and that intern staffs and residents, as well as those to whom the care of these patients is entrusted, can be so educated as to make the employment of spinal anesthesia a constantly more safe and beneficial procedure.

RECOMMENDATIONS OF THE COMMITTEE

The recommendations of the committee submitted at the close of its report are here presented:

1. Early establishment of an anesthetic department under the direction of well paid, medically trained, skilled anesthetists.

2. Keeping of more accurate anesthesia records.

3. More frequent medical consultations to assist in evaluating anesthetic risks.

4. Better facilities for the employment of intratracheal anesthesia.

5. Open minded recognition of the fact that among the numerous forms of anesthesia available today, whether local, rectal, intravenous, inhalation or spinal, there is a definite place for each and that there is for each anesthetic and surgical problem a form of anesthesia and a special anesthetic drug or agent which will best meet that problem.

6. More careful discrimination, therefore, in the selection of the form of anesthesia and of the anesthetic agent to be employed in the given case.

7. A wider knowledge on the part of those employing spinal anesthesia, of the uses, actions, effects, dangers and technic of administration of the various drugs or agents available, with a clear understanding of the differences between such agents as novocain, spinocain, pontocain, nupercain, etc.

8. Recognition of the fact and enforcement of the principle that it is professionally criminal for anyone to employ any spinal anesthetic agent who is not personally familiar with its use.

9. Greater discrimination, also, in the selection of spinal anesthetic agents themselves, depending upon the type and duration of the proposed operative procedure, desired position of patient during operation, general status of patient, desired level of anesthesia, etc.

10. Discontinuance of the use of isobaric solutions in spinal anesthesia except in young patients of robust health requiring operations of short duration, and a relatively low level of anesthesia.

11. Use only of the pontocain-glucose solution when using pontocain as the spinal anesthetic agent, thus assuring a hyperbaric solution.

12. Use of nupercain (Jones Solution—1:1500) for operations of long duration or if the Trendelenburg position is desirable.

13. More careful attention to the technic of the administration of spinal anesthetics: (*a*) greater attention to pre-anesthetic medication; (*b*) intelligent determination of dosage; (*c*) closer attention to required position of patient on table; (*d*) attainment and recording of restricted levels of anesthesia; (*e*) appreciation of danger signals and prompt employment of indicated therapy.

14. Instruction of nurse anesthetists in the care of patients under spinal anesthesia.

SUMMARY*

1. During the five-year period from January 1, 1936, to January 1, 1941, 19,529 anesthetics, exclusive of local and intravenous anesthetics, were given at Queens General Hospital. Of these 16,273 were inhalation anesthetics, 3,193 were spinals and 63 were rectals.

2. Among these cases there were seven fatalities under inhalation anesthesia which in part, at least, were considered attributable to the anesthetic.

* During the two years that have elapsed since the completion of the period covered by the report, there has been a definite improvement in our results, as indicated herewith:

Year	Number of Spinal Anesthetics	Deaths
1941	1,023	2
1942	1,066	0

From the opening of the hospital therefore, on November 18, 1935, to January 1, 1943, the number of spinal anesthetics administered totals 5,282. There were fortunately no deaths during 1942 but the two which occurred during 1941 make nine the aggregate number of fatalities for the entire period. This is one fatality in 587 cases, or .17 per cent.

3. There were seven fatalities under spinal anesthesia, although one of these, occurring in an eighty-three year old male, after the conclusion of his operation, was thought to be due to a coronary occlusion. It is nevertheless here included as a spinal death.

4. There were four deaths under rectal anesthesia attributable, it was thought, to the anesthetic.

5. Of the seven cases under inhalation anesthesia only one was a real emergency. The others for the most part were non-urgent or elective in type.

6. Four of the seven cases under spinal anesthesia were definite emergencies and practically all were desperate cases in which both the surgical and the anesthetic risks were considerable.

7. The pathological state in the inhalation cases, with one marked exception, (peri-arteritis nodosum) was for the most part comparatively simple, whereas that in the spinal case was complicated and diverse and competent in itself to cause death.

8. The administration of pontocain in the spinal cases was considered faulty, as it was employed without the admixture of glucose, it was used in unnecessarily large doses, and proper attention was not paid to the position of the patient on the table either at the time of the spinal injection or during the subsequent operative procedure.

9. By the restricted use of isobaric solutions, the selection of hyper- or hypobaric solutions in accordance with the requirements of the case, meticulous attention to the appropriate position of the patient on the table as well as to other necessary technical points, it is believed that the dangers from spinal anesthesia can be minimized.

10. Recommendations were made to improve the anesthesia service, and to minimize future fatalities occurring under anesthesia.

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SUPERNUMERARY BREASTS*

WITH SPECIAL REFERENCE TO THE PSEUDOMAMMA TYPE

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CONGENITAL supernumerary breasts are not uncommon, but a supernumerary breast of the pseudomamma type, as classified by Kajava, is a relatively rare phenomenon. This belief is further substantiated by Deaver and McFarland, especially so if the supernumerary breast is found in the inguinal region, for, in reviewing over 10,000 cases of polymastism, they found only twelve cases in which this anomaly occurred in the inguinal region. It is interesting to note that a study of the literature on supernumerary breasts discloses the fact that this clinical anomaly has been overlooked somewhat by medical authors, and that detailed descriptions or accurate case records are difficult to find. It may be that what is written in this paper may be repetitious, but it is hoped that those of the medical profession who have seen supernumerary breasts of the pseudomamma type in the past will be stimulated to the point of submitting cases, photographs, and other pertinent data.

EMBRYOLOGY

Traced from its embryonal origin, the human breast arises from an epidermal ridge or primitive "milk line," which extends between the upper and lower limb buds on either side of the midline. In the second month of intrauterine life, breast anlage appear. These breast anlage appear in the embryos of all mammals, to be developed or suppressed according to phylogenesis. In man the anlage appear in the form of an evagination on each side in the pectoral region at the site of the normal breast, and the remaining anlage are suppressed and disappear. When suppression of any of the rudimentary anlage fails, and when the so-called "milk spots" develop unduly, supernumerary breasts appear at different points along the course of the epidermal ridge.

Although there are no records to aid and enlighten us in the study of the historical aspects of the subject, certain conclusions may be surmised from the facts that the Phoenician goddess, Astarte, was frequently portrayed as having an accessory number of mammary glands, and that the well known goddess Diana was usually represented with her trunk covered with large and well formed mammae.

Geoffroy-Saint Hilaire, in 1836, suggested that man was descended from animals having multiple breasts. Darwin (1871) in his "Descent of Man" called attention to the fact that supernumerary breasts should be considered an atavistic manifestation. Champney believes that supernumerary mammary glands are enlarged sweat glands and not true breasts, a theory which was supported by Tandlaus' observation of a patient in whom there was complete failure of development of the breast and nipple, together with total absence of sweat glands all over the body and partial absence of the sebaceous glands.

CLASSIFICATION

Complete supernumerary breasts are exceptional. Usually supernumerary breasts appear as polythelia or pseudomamma. Kajava classified congenital supernumerary breasts as shown in Table 1.

INCIDENCE AND LOCATION

Supernumerary mammary glands, or polymastia, and supernumerary nipples, or polythelia, are said to occur rather more

* From the Surgical Service of the Station Hospital, Moody Field, Georgia.

frequently in the male than in the female. De Cholnoky, in 1939, in an excellent review of the literature on supernumerary breasts, reported that one additional breast

Table 1
KAJAVA'S CLASSIFICATION OF SUPERNUMERARY BREASTS

Type of Breast	Nipple	Areola	Gland Tissue	Fat Tissue
Complete	Present	Present	Present	Present
Supernumerary	Present	None	Present	Present
Supernumerary	None	Present	Present	Present
Aberrant	None	None	Present	Present
Pseudomamma	Present	Present	None	Present
Polythelia	Present	None	None	None
Polythelia areolis	None	Present	None	None
Polythelia pilosa	Only a patch of hair is present			

occurs in from 60 to 65 per cent of the cases, two in 30 to 35 per cent, three in 3.5 to 4 per cent, and four in 1.5 to 2 per cent. It seems, therefore, that the relative incidence of supernumerary breasts diminishes with the increase in the number of those organs observed in one person.

In general, more accessory mammae are noted on the left side of the body than on the right, and a great many more are observed below the normal breasts than above them. Those situated below the normal breast are usually medial to the normal breast, whereas those above the normal site are usually found lateral to the normal breast region. However, cases have been reported in which supernumerary breasts have occurred on the cheek, neck, ear, tragus and helix, upper part of left arm, thorax and abdomen, shoulder, back, lumbar region, pubic and inguinal regions, flank and hip, thigh and Scarpa's triangle, thigh and dorsolateral aspect, buttock, vulva, labia majus and minus. Supernumerary breasts located in these atypical regions are said to be rare and usually asymmetrical when they do occur. In most cases, these abnormal organs are very rudimentary and suppressed in their development, and are often represented by a minute nipple or pigmented areola.

Deaver and McFarland compiled a series of cases of atypical locations of supernumerary breasts, and among those noted were twelve cases of pubic and inguinal accessory mammae. Four of these cases occurred in males, six in females, and two in sex unknown. It was our fortune to see a case of an extremely large supernumerary breast of the pseudomamma type located in the left inguinal region of an otherwise normal, colored, adult male. In reviewing the literature, we found such little mention of this type of congenital anomaly that we are reporting this case at this time, together with those cases of Deaver and McFarland in which supernumerary breasts occurred in the inguinal region of the male.

CASE REPORTS (DEAVER AND MCFARLAND)

1. *Steinborn and Mosig. Münch. med. Wchnschr.* Vol. 471, 1900. The subject was a man forty-seven years old. In Scarpa's triangle on the inner aspect of the left thigh there is a hemispherical enlargement like the mammary gland of a virgin, about puberty, surmounted by a well formed but long nipple surrounded by a dark areola in which grew a number of dark hairs. There was no secretion.

2. *Knox.* Reported from Dr. D. N. Knox's notes by Dr. Wm. Sneddon, Glasgow Medical Journal, 1879, n. s., XI, 92. The patient, a full-grown man, came to consult about a tumor in his groin which he said had always been there but which had, of late, been growing rather larger, and had given him both bodily and mental uneasiness. On examining the tumor it proved to be an extra mamma with well formed nipple situated upon the inner side of the right thigh close below the external inguinal ring. It was about 2 inches long and 1½ inches broad, but was evidently tumified at the time I saw it, probably from some irritation.

3. *Dietschy. Correspondenzbl. f. schweiz. Aerzte, Basle,* 43: 366, 1913. The subject was a man twenty years of age suffering from pulmonary tuberculosis. On the inner side of the left thigh, 12 cm. from the upper border of the symphysis pubis there is a typical little mammary gland. It is somewhat oval in shape and is surrounded by an areola 12 cm. long and 0.8 cm. broad. The papilla is 0.4 cm. in diameter and its height 0.2 cm. It was a little smaller by actual measurement than his left pectoral mamma and more deeply pigmented. It also

has a few dark hairs which the pectoral mamma lacks.

4. *Hoepfner.* Inaugural Dissertation, Jena, 1899. The subject was a man of about thirty years. He had a supernumerary mammary gland upon the inner aspect of the left thigh 11 cm. below the symphysis pubis. It appeared as a darkly pigmented wart.

5. *Romiti.* Anatomia dell'Uomo, Vol. II. Is said by Fiori (*Bull. d. r. Acad. Med. di Genovo,* 20: 369, 1905, to have described a mammary gland in Scarpa's triangle.

6. *Sacasa, Roberto.* (Thése de Paris, 1867.) This report says that in 1863 a man appeared in Velpeau's clinic with a mamma-like formation surmounted by a kind of nipple, in the upper inner aspect of the left thigh. The great surgeon called it a lipoma, and discussed its resemblance to a mammary gland. The man refused to be operated upon, so the true nature of the enlargement is not known.

Since there are so few cases of supernumerary breasts in the inguinal region of the male reported in the literature, it therefore appears warranted to add another case in detail.

A. M., a twenty-eight year old colored male, Case No. 531, entered the surgical service of the station hospital on April 13, 1942, because of a tumor mass of the left inguinal region which had been present for many years.

His primary reason for seeking hospitalization was that this tumor mass resembled a normal, adult, female breast, fully developed with nipple and areola, and because of this, he was subjected frequently to ridicule and embarrassment whenever he exposed his body in the soldiers' barracks while dressing and bathing. The patient does not recall just how long he had this anomaly, but he believed that it came on at puberty and it had not changed in size or shape for the past six years. There had never been any discharge from the nipple, pain, or any other abnormal symptom referable to the tumor mass.

FIG. 1. Lateral view showing nipple, areola and gland.

FIG. 2. Tangential view of supernumerary breast, left inguinal region.

The past history was noncontributory, in that he had only the usual childhood diseases, and no injuries or surgical operations. There was no familial history of supernumerary breasts or other congenital anomalies. The family history was negative for organic disease and the history by systems was likewise essentially negative.

Physical examination revealed a colored male, age twenty-eight, who was normal in all respects except for the presence of a large accessory breast in the left inguinal region, inferior to Poupart's ligament and lying between the anterior superior iliac spine and the pubic tubercle. (Figs. 1 and 2.) This accessory breast resembled a normal, fully developed, female breast, with a normally developed nipple and areola. The nipple was directly in the line of the embryonal milk ridge. The breast tissue felt firmer than female breast tissue, but other than that, it grossly resembled a normal female breast in all respects. Measurements were noted as follows: Length, 12.7 cm; width, 7.6 cm.; height, 4.5 cm. The areola measured 3.2 cm. in diameter.

The urinalysis, serology, and the complete blood counts were essentially negative. A

roentgenological examination of the tumor mass revealed that the mass contained no calcified bodies and was not attached to any underlying bony framework. (Fig. 3.)

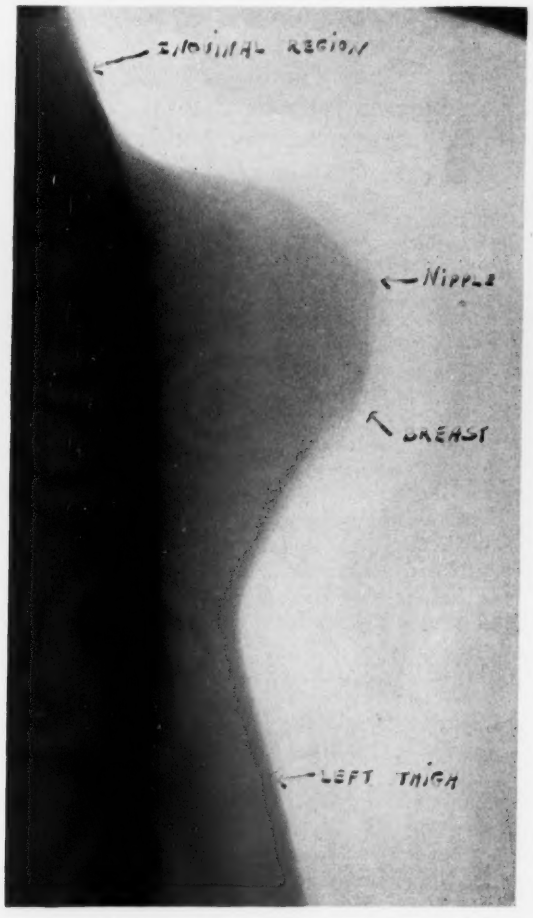

FIG. 3. Photograph of roentgenogram outlining soft tissue structure.

A diagnosis of supernumerary breast of the left inguinal region, congenital in origin, was made.

On April 15, 1942, the patient was taken to surgery, and under local infiltration with 1 per cent procaine hydrochloride, a simple mastectomy was performed. The patient had an uneventful postoperative course and was discharged from the hospital on May 4, 1942. (Fig. 4.)

The specimen was forwarded to Lawson General Hospital, Atlanta, Georgia for pathological examination. The gross examination revealed a specimen consisting of a piece of skin 10 by 6 cm., with an elevated nodule resembling a nipple, 1.5 cm. in height and 3 cm. in diameter at its base, covering 150 Gm. of yellowish lobulated tissue. Microscopic examination revealed benign fatty tissue with no evidence of breast tissue. Sections through the nodule resembling a nipple revealed no evidence of ductal elements. A diagnosis of benign lipoma was made.

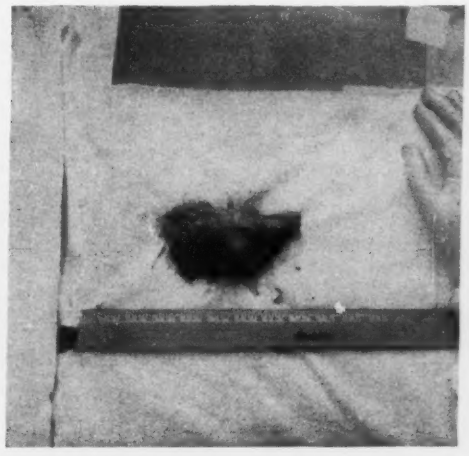

FIG. 4. Gross specimen.

DIFFERENTIAL DIAGNOSIS

This case, in our opinion, is truly a case of congenital supernumerary breast, pseudomammatous in type as given by Kajava. (Table 1.) We have here a normal colored male who at the age of puberty developed this abnormal breast. Grossly it resembled a female breast having a fully developed nipple, areola, and what appeared to be glandular tissue on palpation, except for a somewhat firmer consistency. Only the microscopic examination revealed the true condition, namely, a replacement of the glandular tissue by fatty tissue. According to De Cholnoky, supernumerary breasts are frequently diagnosed as lipomas, for in four of his eleven cases clinically diagnosed as lipomas, microscopical examination established the presence of breast tissue. Thus, one can make, clinically, an undifferentiated diagnosis of supernumerary breast without regard to its specificity. It remains for the pathologist to determine the presence or absence of glandular tissue. Deaver and McFarland stated that in men having supernumerary breasts, unless microscopic examination was made, it would be impossible to determine whether supernumerary breasts have glandular tissue or not; whereas in women the presence of glandular tissue can be determined with

certainty if the subject becomes pregnant and lactates.

Accessory mammae are also to be differentiated from hypertrophied sudariparous and sebaceous glands, lymphadenitis, chronic lymphadenopathy caused by syphilis, tuberculosis, Hodgkin's disease, lymphsarcoma, or metastatic carcinoma.

TREATMENT

The harmless existence of the supernumerary breast requires no medical or surgical treatment. It is only when the accessory breast has an abnormal discharge or location that surgical removal may be requested by the patient. In our case, the unusual size of the breast and its resemblance to a normal female breast caused him no end of embarrassment and shame. Thus, for cosmetic and psychological reasons it was deemed best to remove the breast.

The operation itself is usually a simple procedure, and recovery is rapid and uneventful. The patient goes on to lead a full and happy life, satisfied with the knowledge that he or she is the equal of all other men or women.

CONCLUSIONS

Polymastia is a common congenital malformation of which the literature shows the reported occurrence of upward of 10,000 cases, but the development of a supernumerary breast in the left inguinal region in the male is a very rare phenomenon.

The embryology, classification, incidence, location, differential diagnosis, and treatment of supernumerary breasts are discussed.

There are definite indications for surgical intervention in polymastism and they are as follows: painful or disfiguring supernumerary breasts, and the presence of a malignancy in these aberrant glands.

A case is reported, wherein a supernumerary breast, pseudomamma type, was removed from the left inguinal region of a colored, adult male. Insofar as we have been able to ascertain by a review of the literature, this reported case constitutes the fifth case of reported supernumerary breasts in the inguinal region of the male.

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LITTRÉ'S UMBILICAL HERNIA†

CASE REPORT

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TWO years ago the author reported on the subject of "Right Paraduodenal Hernia," adding the forty-seventh case to the literature of that subject. A few months ago we encountered a case that presented an unusual and perhaps unique picture of one variety of the condition known as Littré's hernia.

In 1700, Alexis Littré recorded two cases of inguinal hernia in which an intestinal diverticulum or pouch of some sort was the sole occupant of the sac. The possibility of this condition had been suggested first following an autopsy in 1683 by Frederik Ruysch, a famous Dutch anatomist and atlas maker. Littré described these pouches as secondary formations; he thought they resulted from traction on the part of the gut within the sac and hence regarded them as partial enteroceles. Lesions of this latter type were accurately described in 1777 by August Gottlieb Richter in a treatise on hernia which is still an acknowledged classic, and this type of hernia—partial herniation of the antimesenteric portion of the gut—is today still catalogued as a Richter's hernia though it had been observed earlier (1772) by Johann Casper Lavater.

In 1809, Johann Friedrich Meckel* was the first to classify the different varieties of intestinal diverticula. The most important of these and the one to which his name has been given, is that which represents an incomplete obliteration of the omphalomesenteric or vitelline duct. With this diverticulum situation clarified, a review showed that the lesion which Littré had described over a century before was a Meckel's diverticulum alone in a hernial sac. Riecke, having observed a strangulated femoral hernia of Meckel's diverticulum in 1834, was the first in 1841 to suggest calling them Littré's hernias.

Considerable confusion exists in the literature over these three clinical entities: (1) Richter's hernia—a partial enterocele; (2) Littré's hernia—a hernia of Meckel's diverticulum alone, and rarer then (3); and (3) mixed Meckel's hernia—a hernia of Meckel's diverticulum, plus gut or omentum, or both.

Just why Littré's should be rarer than Meckel's nobody has explained. Perhaps it is due to the fact that a diverticulum has no propulsive or expansive characteristics, whereas gut and omentum have both. The chances are the gut or omentum arrived in the sac first and the diverticulum followed, not by adhesive but by cohesive traction.

Speaking of confusion, Moschowitz, in Johnson's "Operative Therapeusis" (1915), clearly distinguishes between a Richter's

* This Meckel, according to Garrison, came of a famous medical family. His grandfather, of the same name, graduated from Goettingen in 1748, at the age of twenty-four, his thesis being on the (Meckel's) sphenopalatine ganglion of the fifth cranial nerve. Three years later he was Professor of Anatomy, Botany and Obstetrics (*sic!*) at Basle. His father, Philipp Friedrich Theodor Meckel, graduated from Strassburg in 1777, at the age of twenty-one, his thesis being on the inner ear, and two years later he was Professor of Anatomy and Surgery at Halle. His brother, August Albrecht Meckel, at thirty-one, became Professor of Anatomy and Forensic Medicine at Bern. Our Méckel became Professor of Pathology, Comparative Anatomy and Embryology at Halle. Thus this family, in three generations, produced four professors, all before they had passed their thirty-first year.

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hernia and a Littré's hernia; whereas Stone, in Lewis' "Surgery" (1929), shows an illustration labelled "Littré's or Richter's Hernia" (which is definitely a Richter's hernia), and he repeats the statement in the text. It is unfortunate that such a popular reference work carries the implication that a Littré's hernia and a Richter's hernia are one and the same thing.

As to Littré's hernia, Babcock defines it as "a sac containing a blind diverticulum only, such as Meckel's diverticulum or the appendix vermiformis," whereas the blind diverticulum that Littré described was a vitelline duct vestige and not the appendix, though this is another vestigial organ. Keeley states that the sac may also contain "small or large intestine, and/or omentum," and Watson, an acknowledged authority on hernia, says it "may be accompanied by small intestine . . . or omentum alone," a statement reiterated by DaCosta. However, Weinstein's recent paper (December, 1938) on Littré's femoral hernia brings us back again to the original basis when he says "that the title of Littré's hernia is applied only if the diverticulum is of Meckel's type, and is the sole occupant of the hernial sac."

It is not our purpose here to go into lengthy descriptive details concerning Meckel's diverticulum as Goodman's excellent article covers the ground thoroughly. Suffice it to say that normally the vitelline duct begins to atrophy at the seventh week of fetal life, is completely obliterated by the twelfth week, and at birth no remnant is visible. Failing to perform according to schedule, there may be present at birth anything from a mere nubbin of a closed pouch (generally on the antimesenteric border of the gut, generally without a mesentery, and at a point 12 to 36 inches from the ileocecal valve) to a continuous open tube extending from the ileum to the umbilicus and discharging feces. Consequently, the shape and size, and the mobility or fixation of Meckel's diverticulum varies within quite large limits.

A Meckel's diverticulum is subject to all the lesions that obtain in other parts of the gut; inflammation, ulcer, hemorrhage, foreign body, tumor, obstruction, strangulation, gangrene, torsion or volvulus, intussusception (in approximately 25 per cent of the reported cases), and herniation (in another 25 per cent). Herniation of the mixed Meckel's type or of the true Littré's type is possible at any of the sites of external herniation of the abdomen, and the following varieties have been reported: inguinal, femoral, umbilical, ventral (incisional), crural and sciatic. We could find no record of any case of the following types: spontaneous ventral, diaphragmatic, obturator or lumbar. Of the many possible types of internal herniation only one case has been recorded, a retrocecal hernia.

Littré's own description of his cases can, after more than 200 years, be read today without modificat on other than the knowledge that he was describing a hernia of Meckel's diverticulum and not, as he supposed, of what is now termed a Richter's hernia. Witness his accurate remarks on the diagnostic features, as given by Mason:

"The diagnostic signs, making this type of hernia recognizable before the operation, are:

"1. The patient goes to stool during the whole course of the illness as, the intestinal canal being uninterrupted, the excrements are at perfect liberty to pass from one end to the other.

"2. The patient has no hiccough, or very occasionally.

"3. He does not vomit, at least by comparison less frequently than in ordinary herniae. The vomitus is never fecal matter.

"4. The patient's belly is never fat, stretched or full of wind as in ordinary herniae.

"5. The tumor in the groin is formed more slowly and never becomes so large.

"6. The inflammation, fever, pain or other symptoms which may accompany this peculiar kind of hernia, are less severe and take longer to manifest themselves than in other herniae.

"The diagnostic signs which make this particular hernia recognizable during the operation are:

"1. In ordinary cases of hernia, the entire circumference of the intestinal body is engaged in the hernial sac. In this hernia there is only one part in the sac.

"2. The portion of the intestine which forms an ordinary hernia is found doubled in the shape of an arc in the sac. In this particular kind (which concerns us), this portion is single, situated perpendicularly and terminated by a very distinct end.

"3. An ordinary hernia is often formed by intestine and omentum together. This particular kind is always made by the intestine alone."

Operation on an uncomplicated Meckel's diverticulum has a mortality rate slightly above that of appendectomy, i.e., 3 to 5 per cent. If the diverticulum is diseased but *not* herniated, the rate runs as high as 35 to 40 per cent. If the diverticulum is diseased and *is* herniated, the operative mortality extends from 45 to 50 per cent.

In diverticular hernia, the inguinal variety is commonest, being two and one-half times as frequent as the femoral or the umbilical types. Following the rule in simple hernia, in the femoral variety females outnumber the males 3 to 1; whereas in the inguinal variety exactly the reverse is true. In both of these the majority are on the right side, and most of the cases are in adults and the middle-aged. (Parenthetically, we might add that Richter's hernia is commonest in the femoral region.) In the umbilical variety sex is stated so infrequently that no reliable figures are available. Age, however, is definitely a factor, over 85 per cent being found in the newborn or in very young infants.

There is a marked discrepancy between the anatomical and the surgical occurrence of Meckel's diverticulum, due to the fact that the pathologist explores the entire abdomen, while the surgeon usually explores only a limited area of the abdomen. Anatomically, Meckel's diverticulum is found in ½ to 2 per cent of humans, according to various postmortem observations. The surgical incidence seems to be considerably less, about one-tenth, and varies from one case in 700 laparotomies at the Mayo Clinic, to one case in 450 at the Vanderbilt University Hospital, to one case in 400 at the New York Post-Graduate Hospital, an average of one case in 500 laparotomies. Further, Forgue and Riche, in 1907, analysing 600 cases of Meckel's diverticulum, found that fifty-two (8.7 per cent) or about one in twelve occurred in hernias. On this basis one might anticipate encountering some type of Meckel's hernia once in 6,000 laparotomies. Finally, our own tabulation shows that 20 per cent of Meckel's hernias are umbilical, and at this rate one might anticipate encountering a Meckel's umbilical hernia once in 30,000 laparotomies, surely an astronomical expectancy. True Littre's hernias are even rarer.

TABLE 1
REPORTED CASES OF MECKEL'S DIVERTICULUM IN A HERNIA
Summary

Type	Gray, 1934	Bird, 1941	Total	Per Cent
Inguinal	89	6	95	52.19
Femoral	33	4	37	20.33
Umbilical	37	1	38	20.88
Ventral (incisional)	0	1	1	0.55
Crural	0	1	1	0.55
Sciatic	1	0	1	0.55
Retrocecal	1	0	1	0.55
Not stated	8	0	8	4.40
Total	169	13	182	100.00

Simple congenital umbilical hernia is rare enough, and occurs about once in every 10,000 births. Such a hernia, containing a diverticulum, is considerably rarer. The number of cases of Meckel's diverticulum in a hernia, tabulated up to February 1934 by Gray, was 169, of which only thirty-seven were of the umbilical variety. To this 169 we have been able to add twelve non-umbilical cases, and our present umbilical case, the first since 1928, and which makes

the thirty-eighth case to be reported. Several of the cases tabulated were of the mixed Meckel's type. We have not yet been able to determine the exact number of true Littré's hernia on record.

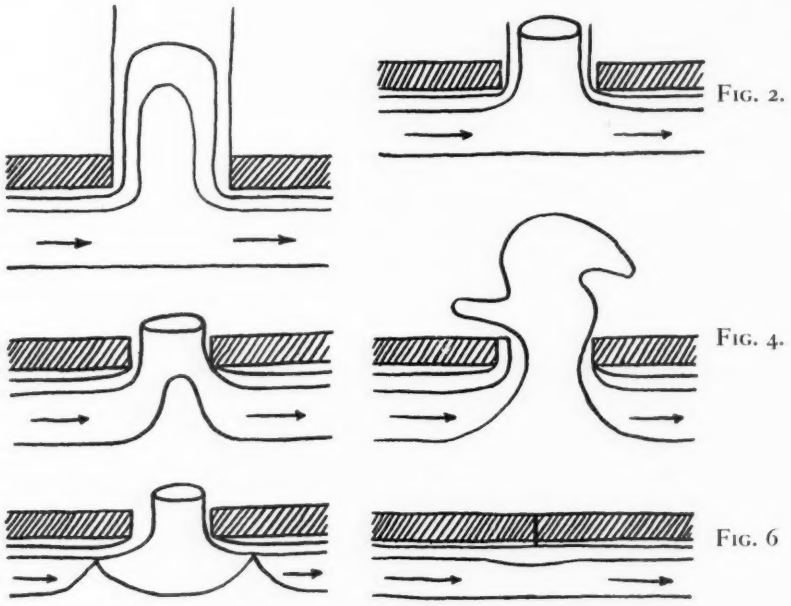

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6

Fig. 1. The anatomy at birth, showing an apparently normal cord but containing an unsuspected hernia sac into which protrudes a Meckel's diverticulum.

Fig. 2. Fourth day, showing the cord, hernia sac and the diverticulum sloughed off at the point of ligation.

Fig. 3. Fifth day, showing the beginning of the eversion of the mesenteric border of the gut through the opening in the diverticulum.

Fig. 4. Seventh day, showing the eversion completed and the main pouch with its two secondary pouches. The presenting surface was, of course, mucosa. At operation, on the twenty-fourth day, the two lateral openings, mistaken for fistulas, were sutured.

Fig. 5. At operation after the eversion was reduced it was discovered that the two sutured "fistulas" had been converted into two complete obstructions. The eversion was then re-established, as in Figure 4 and the offending sutures removed.

Fig. 6. The operation completed, showing the lumen of the gut approximately normal in diameter.

CASE REPORT

The patient was a male, colored baby, born of an eighteen year old unmarried mother, para II, on March 17, 1941, at the Wilmington General Hospital. The baby weighed 6 pounds 12½ ounces, and appeared to be physically normal in all respects. There was no apparent enlargement (Fig. 1) of the umbilical end of the cord which was tied off in the usual manner. On the third day the cord was red and had a slight purulent discharge, and on this day the Pediatric Department was called in to supervise the feedings, etc. On the fourth day the cord sloughed off (Fig. 2), and later that day some feces were passed via the umbilicus. On the fifth day a loop of gut or a pouch began to present at the umbilicus (Fig. 3), and by the sixth day this extended 3½ inches on to the abdominal wall.

On the seventh day the Surgical Department was called in consultation. The weight was then 5 pounds 15 ounces. Our examination showed a pouch of intestine on the abdominal wall (Fig. 4) some 5 inches long and 2½ inches in diameter with a blind end. From the right side of this pouch was a secondary pouch, arising 1½ inches from the umbilicus with a diameter of ½ inch, and extending 2 inches to end blindly. From the left side near the distal end of the main pouch was another

secondary pouch nearly 1 inch in diameter and extending 2 inches to end blindly. The extra-abdominal portion of the sac (peritoneum) was missing. On palpation the pouch and the absence of symptoms of obstruction; as a matter of fact, stools were also passed through the rectum daily both before and after operation.

TABLE II

REPORTED CASES OF MECKEL'S DIVERTICULUM IN A HERNIA

Tabulation

Report No.	Author	Date	Cases	Inguinal	Femoral	Umbilical	Ventral (Incisional)	Crural	Sciatic	Retrocecal	Not Stated
1	Pabst	1910	123	66	24	25	0	0	0	1	7
2	Wellington	1913	27	14	2	10	0	0	0	0	1
3	Burianek	1913	1	0	1	0	0	0	0	0	0
4	Harf	1919	1	0	1	0	0	0	0	0	0
5	Quenu	1921	1	1	0	0	0	0	0	0	0
6	Bettman	1921	1	1	0	0	0	0	0	0	0
7	Ludbrook	1922	1	0	1	0	0	0	0	0	0
8	Brodnax	1924	1	0	0	0	0	0	1	0	0
9	Lanman	1924	1	1	0	0	0	0	0	0	0
10	Littler	1924	1	0	1	0	0	0	0	0	0
11	Harrington	1926	1	0	1	0	0	0	0	0	0
12	Bianchi	1927	2	1	0	1	0	0	0	0	0
13	Oliva	1927	1	1	0	0	0	0	0	0	0
14	Sicard	1928	1	0	0	1	0	0	0	0	0
15	Reid	1928	1	1	0	0	0	0	0	0	0
16	Pollidori	1930	2	2	0	0	0	0	0	0	0
17	Sweet	1930	1	0	1	0	0	0	0	0	0
18	Donati	1931	1	0	1	0	0	0	0	0	0
19	Gray	1934	1	1	0	0	0	0	0	0	0
20	Sinclair	1922	1	0	1	0	0	0	0	0	0
21	Folliasson	1932	1	1	0	0	0	0	0	0	0
22	Mason	1933	1	0	1	0	0	0	0	0	0
23	Ittzes	1934	1	1	0	0	0	0	0	0	0
24	Bettinelli	1935	1	1	0	0	0	0	0	0	0
25	May	1935	1	1	0	0	0	0	0	0	0
26	Rodnaev	1936	1	1	0	0	0	0	0	0	0
27	deTroyer et duBourguet	1937	1	1	0	0	0	0	0	0	0
28	Keeley	1937	1	0	0	0	1	0	0	0	0
29	Quiri	1938	1	0	0	0	0	1	0	0	0
30	Weinstein	1938	1	0	1	0	0	0	0	0	0
31	Ringo & Charlton	1940	1	0	1	0	0	0	0	0	0
32	Bird	1941	1	0	0	1	0	0	0	0	0
Total			182	95	37	38	1	1	1	1	8
Per cent			100	52.19	20.33	20.88	0.55	0.55	0.55	0.55	4.40

Tabulation of Reports Nos. 1 to 19 after Gray; Nos. 20 to 32 by the author.
No. 20, Sinclair's case, contained also a Richter's hernia, the only combined case in the literature.

felt as though it contained omentum; there were no gurgles. The neck of the pouch was adherent to the umbilical ring, which was ¾ inch in diameter, and from the left side of the ring feces were passing through a small opening. The main pouch could not be reduced because of edema and the adhesions, nor could it be pulled out further. The flow of feces accounted for the progressive loss of weight

The surface of this trilocular pouch appeared to be mucosa but a differentiation between mucosa and peritoneum with massive granulations could not surely be made. However, a tentative diagnosis was made as follows: congenital umbilical hernia, sac contents either cecum and appendix or Meckel's diverticulum; fecal fistula. Operation was advised and accepted by the family. In consultation with the

pediatrician it was decided to wait a few days in an effort to build up the patient. Unfortunately, the baby lost ground steadily and on the twenty-fourth day the weight was only 4 pounds 13¼ ounces, a loss of one-third of the birth weight, and operation was decided upon as a matter of necessity.

Fig. 7. The patient in the recumbent position.

Fig. 8. The patient in the upright position.

On April 10, 1941 under novocain anesthesia the abdomen was opened below the umbilicus where nothing was noted. On enlarging the incision up to the umbilicus two loops of ileum seemed to enter the ring from within. The left external opening through which feces were still passing was then sutured as was a similar opening on the right side, following which the neck of the pouch was freed of its adhesions to the ring. Then on pushing the main pouch back into the abdominal cavity it suddenly turned outside in, and it was apparent that it had been the mesenteric side of a Meckel's diverticulum completely everted by passing through the opening made by the sloughing off of the top of the cord and of the parietal peritoneum. On passing a soft catheter proximally and distally it was found that the two sutures we had placed had very neatly closed (Fig. 5) the lumen at both points. The eversion was then re-established, the two sutures removed and the pouch inverted once more.

The picture then was that of a Meckel's diverticulum with a base of 1½ inches and a height of ¾ inch to the opening made by the sloughing. How much greater the original height had been is a matter of conjecture, probably another ¾ inch. The remaining part of the diverticulum was then excised, the ileum sutured longitudinally with two rows of fine silk, leaving a lumen of approximately normal diameter. The diverticulum was 12 inches from the ileocecal valve. The umbilicus was then excised and the hernia repaired quickly by longitudinal suturing (silk, Pagenstecher, dermal) without drainage (Fig. 6). Just before closing the peritoneum 150 cc. of Ochsner's papain solution was run into the abdomen as a protection against colon bacillus infection. For the final stages of the closure a few whiffs of vinethane were given. The patient was returned to the ward in fairly good condition.

The pathological report stated that the diverticulum contained no gastric, duodenal, pancreatic or other heterotopic tissue.

Postoperatively, the baby did fairly well for three days, gaining 5 ounces in weight. On the fourth day it developed a pneumonia in the left lower lobe and succumbed on the sixth day at the age of thirty days. The autopsy, in addition to the left pneumonia, showed a beginning pneumonia in the right lower lobe. There was a moderate degree of plastic peritonitis at the operative site, which probably represented an infantile reaction to the papain in solution, the adhesions of which were easily separated. Also, the liver showed extensive fatty degeneration.

SUMMARY

1. Meckel's diverticulum in a hernia is discussed and the recorded (182) cases tabulated to date.

2. Littré's hernia is differentiated from the lesions with which it is confused.

3. A new case of the umbilical variety of Littré's hernia is reported, and its operative rarity estimated.

4. The case presented, the thirty-eighth in the literature, is perhaps unique.

CONCLUSIONS

1. Hernia of the umbilical cord is so rare that its possible presence is usually not suspected at delivery.

2. The sequelas of such an unsuspected hernia may be fatal.

In the absence at birth of physical findings indicating such an anomaly, there is no sure or even satisfactory method of preventing an accident.

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EXPLORATION OF THE COMMON BILE DUCT*

REVIEW OF 165 CASES

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THE following analysis of 165 cases in which the common bile duct was explored at operation was undertaken to add further statistical information and to clarify further this important problem. The average surgeon is prone to avoid opening the common bile duct because of additional dangers and technical difficulties that may be encountered. However, Lahey,[1] an advocate of common duct exploration, believes that in the hands of a competent surgeon who has had experience in biliary surgery, such a step does not entail any more danger to the patient.

TABLE I
YEAR

Year	Cases
1921–25	5
1926–30	30
1931–35	42
1936–40	88
Total	165

TABLE II
SEX

Sex	No. Patients
Male	51
Female	114
Total	165

TABLE III
AGE

Age (Decades)	No. Patients
0– 9 years	0
10–19 "	1
20–29 "	6
30–39 "	27
40–49 "	49
50–59 "	45
60–69 "	34
70–79 "	3
Total	165

At the Henry Ford Hospital over a period of the past twenty years cholecystectomy has been performed on 2,117 patients. During this same period of time 165 choledochotomies with exploration of the common bile duct were performed.

TABLE IV
DURATION OF SYMPTOMS

Duration	Recent Attack	Earliest Symptoms
1 day to 1 week	56 patients	1 patient
1 week to 2 weeks	24 "	None
2 weeks to 3 weeks	6 "	"
3 weeks to 1 month	6 "	1 patient
1 month to 2 months	8 "	2 patients
2 months to 3 months	2 "	5 "
3 " to 6 "	2 "	6 "
6 " to 1 year	1 patient	15 "
1 year to 2 years	1 "	12 "
2 years to 3 "	None	4 "
3 " to 6 "	1 patient	22 "
6 " to 12 "	None	17 "
12 " to 18 "	"	7 "
18 " plus	"	9 "
Unrecorded	58 patients	64 "
Total	165	165

TABLE V
NATURE OF SYMPTOMS

Location of Pain	With Nausea, Vomiting or Eructation	Without Nausea, Vomiting or Eructation
Right upper quadrant pain with radiation to back	56 patients	11 patients
Epigastric pain	29 "	5 "
Right upper quadrant pain	27 "	4 "
Epigastric pain with radiation to back	18 "	1 patient
Left upper quadrant pain	3 "	None
No abdominal pain (pruritus or chills or biliary fistula)	10 "	1 patient
Unrecorded	None	

* From the Division of General Surgery, Henry Ford Hospital, Detroit.

Therefore, for approximately every thirteen cholecystectomies one choledochotomy was done.

Sex was found to be a significant factor because of the 165 cases in which the common duct was explored, 114 or 69 per cent were females and fifty-one or 31 per cent were males. Other authors[2] have found this to be the case also.

Age appeared to play a rôle because over half of these patients were in the fifth and sixth decades; but the extremes were not free as the youngest patient was nineteen years old and the oldest seventy-three years.

Symptoms. Behrend[3] states "the commonest symptoms of disease of the common bile duct are pain, nausea, vomiting and eructations of gas." Our findings (Table v) corroborate those of Behrend since the great majority of our patients complained of a very definite pain always

TABLE VI
FREQUENCY OF ATTACKS

Frequency of Attacks	No. Patients
Many (above 8 attacks)	85
Numerous (5–8 attacks)	16
Few (0–4 attacks)	51
Unrecorded	13
Total	165

TABLE VII
SEPTIC SYMPTOMS

Symptom	No. Patients
Chills and fever	64
Without chills and fever	101
Total	165

TABLE VIII
INCIDENCE OF CLINICAL JAUNDICE

Jaundice	No. Patients
With jaundice	122
Without jaundice	31
Unrecorded	12
Total	165

TABLE IX
PREVIOUS OPERATIONS ON THE BILIARY TRACT

Operation	No. Patients
Cholecystectomy	18
Cholecystostomy	6
Cholecystectomy Choledocotomy	4
Removal of stones from gallbladder	3
Cholecystectomy Drainage cystic duct	1
Cholecystgastrostomy	1
Total	33

TABLE X
ICTERIC INDEX

Readings	No. Patients
0–9	13
10–19	35
20–29	22
30–39	16
40–49	10
50–59	9
60–69	8
70–79	2
80–89	0
90–99	1
100–109	2
110–119	1
120–129	3
Unrecorded	43
Total	165

TABLE XI
BLEEDING AND CLOTTING TIME

Test	Bleeding	Clotting
Normal	(0–5 minutes) 34 patients	(0–5 minutes—capillary tube) (0–20 " —Howell) 28 patients
Prolonged	(5–10 minutes) 9 patients	(5–10 minutes—capillary tube) (20–40 " —Howell) 23 patients
Very prolonged	(10+ minutes) 1 patient	(10+ minutes—capillary tube) (40+ " —Howell) 3 patients
Unrecorded	121 patients	111 patients

TABLE XII
VAN DEN BERGH REACTION

Reaction	No. Patients
Direct	
Prompt	39
Delayed	14
Negative	6
Unrecorded	106
Indirect	
Normal	9
1–2	7
2–3	6
3–4	7
4–5	7
5–6	6
6–7	1
7–8	15
Negative	1
Unrecorded	106
Total	165

located in the epigastrium usually on the right side and accompanied in most instances by nausea, vomiting or eructation. In a large number of cases onset of these symptoms dated back two or three years. The most recent attack of pain and that which finally brought the patient into the hospital was usually of less than one week's duration. It is interesting that three of our patients suffered left upper quadrant abdominal pain and that ten of them had no pain whatever, their complaint being pruritus, or chills or a persistent biliary fistula.

Chills and fever suggest that an infection is present in the biliary tract. According to Behrend,[3] Symthe includes chills and fever in his summary of "clinical features

TABLE XIII
X-RAY EXAMINATION

X-ray Findings	No. Patients	Verified at Operation
Without stones....	67	66
Non-functioning		Most of these had stones but gallbladder appeared functionless
Gallbladder With stones.....	22	21
		Stones may have been passed before gallbladder palpated
Normal gallbladder..	8	1

Flat Plate	No. Patients	Verified at Operation
Positive.....	2	2
Negative.....	16	3
(Cholangiogram) Pressure—extra biliary.....	1	1
Unrecorded.....	44	

TABLE XIV
BILIARY DRAINAGE TEST

Test	No. Patients	Verified at Operation
Normal.....	22	5
Stones.....	41	33
Infection.....	23	22
Biliary obstruction.....	6	6
Unrecorded.....	73	

TABLE XV
PRESENCE OF BILE IN URINE AND STOOL

Reaction	No. Patients	
	Urine Bile	Stool Bile
Positive.....	89	71
Negative.....	47	33
Unrecorded.....	29	61
Total.....	165	165

TABLE XVI
WHITE BLOOD COUNT

WBC	No. Patients
0–5000.....	5
5001–10,000.....	81
10,001–15,000.....	45
15,001–20,000.....	14
20,001–25,000.....	2
25,001–30,000.....	3
30,001–35,000.....	1
Unrecorded.....	14
Total.....	165

TABLE XVII
PRE-OPERATIVE DIAGNOSIS

Pre-operative Diagnosis	No. Patients	Verified at Operation
Common duct obstruction		
Stone.....	73	57
Stricture or cancer Within duct.....	4	4
Pressure from outside (Ca of pancreas, glands).....	1	1
No Common Duct Obstruction		
Cirrhosis, hepatitis, cholangitis, carcinoma.....	4	4
Cystic duct stone.....	5	5
Cholecystitis, cholelithiasis....	77	43
Miscellaneous, persistent biliary fistula.....	1	1
Total.....	165	165

of stone in common bile duct" but remarks that "in Lahey's series, chills and fever were present in only 4.2 per cent of cases—a remarkably low figure which was attributed to the fact that a large proportion were operated upon early, and also to the practice of exploring the ducts in all biliary operations." Sixty-four cases in our series of 165 complained of chills and fever.

Laboratory Findings. The icteric index was elevated in over half of the cases in this series and this might well be expected since 122 cases were clinically jaundiced. The icteric index (Table x) in the great majority of our cases remained below 50, but in three instances it was between 120 and 129 shortly before operation. The urine contained bile in well over half of the cases and the stool examinations were bile negative in approximately 1/5 of the total cases.

The white blood count was below 10,000 in eighty-eight cases (Table xvi) indicating that in these cases no acute inflammatory process was present. However, in fifty-nine cases the white blood count was between

Table xviii
Liver function

Liver Function	No. Patients
Good	12
Fair	12
Poor	11
Unclassified	14
Unrecorded	116
Total	165

Table xix
Type of risk

Type Risk	No. Patients
Good	94
Fair	59
(Of the 59 patients in this group 20 had severe jaundice, 15 had cardio-vascular, 2 had bronchitis, 1 pulmonary t.b., 6 were afflicted with obesity, 5 with diabetes, 2 with poor livers, 1 with morphine addiction, 2 with epilepsy, 1 with rectal stricture, 1 with acute hepatitis, 2 with malnutrition and old age, 1 with acute pancreatitis.)	
Poor	4
(Of these 4 patients 3 had cardio-vascular, 1 had diabetes.)	
Unrecorded	8
	165

Table xx
Operators

Operators	No. Operations
McClure	64
Fallis	30
Pratt	5
Harkins	1
Lam	8
Marshall	5
Altemeier	3
Davidson	3
Parr	3
Plain	2
Lambert	3
Noel	19
McGraw	5
Allen	11
Beaton	1
Robertson	1
Total	165

Table xxi
Condition of gall bladder

Condition of Gallbladder	No. Patients
Chronic inflammation: stones	65
Chronic inflammation: no stones	60
Acute inflammation	9
Normal gallbladder	4
Gallbladder absent	22
Unrecorded	5
Total	165

Table xxii
Pancreas

Pancreas	Chronic Process (No. Patients)	Acute Process (No. Patients)	Total
Thickened at head	8	0	8
Thickened throughout	36	4	40
Normal	48		48
Unrecorded	70		69
			165

Table xxiii
Dilatation of common duct

Common Duct	No. Patients
Not dilated	29
Moderately dilated	80
Very dilated	15
Unrecorded	41
	165

10,000 and 20,000 and in six other cases above 20,000. This, correlated with the occurrence of fever and chills, suggests further that a rather large number of these patients had biliary tract infections.

TABLE XXIV
STONES IN COMMON DUCT

No. Stones	No. Patients
0	62
1	42
2	20
3	3
4	3
5	1
6++	19
Gravel	6
Unrecorded	9
Total	165

TABLE XXV
COMMON DUCT PROBED OR DILATED

Common Duct	No. Patients
Probed	88
Dilated	30
Not probed or dilated	20
Unrecorded	27
Total	165

TABLE XXVI
ADHESIONS

Adhesions	No. Patients
Present	107
Absent	35
Unrecorded	23
Total	165

TABLE XXVII
CONDITION OF LIVER

Condition of Liver	No. Patients
Scarred	30
Cirrhosis	21
Congested	15
Normal	32
Enlarged	16
Nodular	1
Small	1
Unrecorded	49
Total	165

Bleeding and clotting times were recorded on an insufficient number of patients from which to draw any satisfactory conclusions. Bleeding time was prolonged in ten of the forty-four and clotting time in twenty-six of the fifty-four cases recorded. This indicates that in at least a few cases blood coagulation was definitely prolonged.

Liver function tests were recorded on thirty-five cases in this series, twelve being classified as good function, twelve as fairly good function and eleven as markedly impaired function. Bromsulphthalein, oral and intravenous hippuric acid tests were employed in these cases.

TABLE XXVIII
DRAINAGE OF COMMON DUCT

Type of Drainage	No. Patients
T tube	138
Catheter	17
No drainage: closed	6
Unrecorded	4
Total	165

TABLE XXIX
NATURE OF OPERATION

Cholecystectomy, Choledochostomy	86 patients	Duodenum opened into	3
		Stomach opened into	1
Cholecystectomy, Choledochostomy	41 patients		
Appendectomy, Choledochostomy	19 patients		

Miscellaneous:	Patients
Cholecystectomy, choledochostomy, appendectomy, repair of ventral hernia	3
Choledochostomy, appendectomy, repair of ventral hernia	1
Choledochotomy, release of adhesions	1
Cholecystectomy, choledochotomy	2
Choledochotomy, appendectomy	1
Choledochostomy, rectal dilatation	1
Cholecystectomy, choledochostomy, appendectomy, plication of sphincter	1
Choledochostomy, cholecystjejunostomy, *duodenum opened into*	1
Choledochotomy, " " "	1
Cholecystectomy, choledochotomy, transplantation of cystic duct into duodenum, *duodenum opened*	1
Choledochostomy, transplantation of common duct into duodenum *duodenum opened into*	1
Cholelithotomy	1
Total	165

Duodenal biliary drainage was employed in ninety-two patients and was found to be definitely helpful in arriving at a diagnosis. This was especially true when a positive report was obtained as seen in Table XIV. Our figures, however, do not

approach those reported by Backus[4] who found that in a series of 148 proved cases biliary drainage was correct in 98 per cent of the cases.

It is exceedingly difficult to diagnose common duct pathology by routine *x*-ray examinations excluding of course the cholangiogram. An *x*-ray diagnosis of common duct stone was made in only two instances in our series. The principal value of *x*-ray in the preoperative diagnosis proved to be in the determination of the condition of the gallbladder and the presence of calculi and in this series of the ninety-one *x*-ray diagnoses positive for biliary tract pathology eighty-nine were correct.

The value of the cholangiogram has been repeatedly emphasized by Best,[5] Hunt and Hicken,[6] Danzer,[7] Saralegui[8] and many others. The following two brief case reports taken from this series show how satisfactory such a simple procedure is in determining the patency of the common duct postoperatively.

Table XXX
DRAINAGE

No. Drains	No. Patients Having Cigarette Drains	No. Patients with G.B. Drains
1 drain	41	0
2 drains	38	3
3 drains	39	19
4 drains	3	3
5 drains	1	3

Gallbladder and cigarette drains	11 patients
No drains	1 patient
Unrecorded	6 patients
Total	165 patients

Table XXXI
TIME WHEN BILE CEASED TO FLOW

Post-operative Days	No. Patients
10–20 days	24
21–30 "	41
31–40 "	25
41–50 "	12
51–60 "	3
61–70 "	2
70 days plus	2
Unrecorded	56
Total	165

Case I. Case No. 283653. W. I., sixty-eight years of age, had many attacks of epigastric pain radiating to the back accompanied by nausea and vomiting. There was no jaundice. Lipiodol was injected into a T tube in the common duct one month after cholecystectomy and choledochostomy. *X*-ray revealed no obstruction in the common duct, so the T tube was removed and the subsequent clinical course verified the *x*-ray diagnosis.

Table XXXII
HEALING COMPLETE

Post-operative Days	No. Patients
10–20 days	5
21–30 "	16
31–40 "	38
41–50 "	26
51–60 "	18
61–70 "	4
70 days to 5 mos	5
Unrecorded	38
Dead	15
Total	165

Table XXXIII
RESULTS

Results	No. Patients
Well	120
Second biliary operation necessary	5
Ventral hernia	7
Recurrence biliary symptoms; spontaneous remission	10
Recurrence biliary symptoms without spontaneous remission	1
Died	22
Total	165

Case II. Case No. 300884. W. M., forty-eight years of age, suffered many attacks of epigastric pain accompanied by nausea and vomiting. There was a history of jaundice. One month after cholecystectomy and choledochostomy the clinical course of this patient suggested common duct obstruction. This was verified by cholangiogram. Then warm normal saline was irrigated back and forth through the T tube in the common duct and apparently the obstruction was relieved. Another cholangiogram was then taken and revealed no obstruction. This was verified by the clinical course.

Accuracy of Preoperative Diagnosis. In order to determine the accuracy of the preoperative diagnoses the operative find-

ings were investigated in each case. (Table XVII.) The greatest discrepancy occurred in those cases in which no common duct obstruction was suspected, for of these seventy-seven cases only forty-three proved to have no common duct obstruction.

Findings at Operation. The condition of the gallbladder was investigated as shown in Table XXI. It is not surprising that in twenty-two cases the gallbladder had been removed because thirty-three patients had previously undergone operations on the biliary tract.

TABLE XXXIV
FOLLOW-UP

Time	No. Patients
1 day to 2 months	74
2 months to 4 months	29
4 " to 6 "	19
6 " to 1 year	10
1 year to 2 years	12
2 " to 3 "	5
3 " to 6 "	8
6 " to 9 "	6
9 " to 14 "	2
	165

one-fifth of the cases showed no evidence of dilatation of the common duct. Adhesions were present in 107 cases.

Type of Operation Performed. Table XXIX shows that in the majority of cases cholecystectomy was performed as well as a choledochostomy. In seven cases it was found necessary to open into the duodenum to determine the condition of the ampulla and common duct and in one case the stomach was opened. T tube drainage was used in 138 patients, a plain rubber catheter in seventeen, and in six, drainage of the common duct was not necessary. The duct was probed in 118 cases and the abdominal cavity was drained in all except one case.

Postoperative Course. In five of the cases the wound was completely healed in five days, but in half of the cases healing was not complete until forty days after operation. Bile ceased to flow from the wound in the majority of cases after the first month, but in several cases it persisted for over two months postoperatively.

TABLE XXXV
OPERATIVE MORTALITY AND CAUSES OF DEATH
(Cases that did not leave hospital after operation)

Year	Causes of Death and No. Patients						
	Wound Hemorrhage	Cardiac Failure	Kidney Suppression (Uremia)	Banti's Disease Toxemia Poor Condition	Duodenal Fistula	Ruptured Aortic Aneurysm	Hepatic Insufficiency
1921–25	0	1	0	0	0	0	0
1926–30	1	0	1	1	1	0	0
1931–35	1	2	1	0	0	0	0
1936–40	2	2	0	0	0	1	1
Total	4	5	2	1	1	1	1

The pancreas was thickened and involved in a chronic process in forty-four cases and in an acute process in four cases. In only thirty-two cases could the liver be considered as grossly normal.

The condition of the common duct is summarized in Table XXIII. Slightly over

Results. One hundred twenty patients were completely cured, five required another operation and twenty-two terminated in exitus. Table XXXIII summarizes the results.

The *follow-up* was extended to fourteen years in several instances but after two

months the number of patients seen again in the hospital sharply dropped off from seventy-four to twenty-nine and from then on the decrease was gradual.

Table xxxvi
POST-OPERATIVE DAY DEATH OCCURRED

P.O.D.	No. Patients
1– 5 days	4
6–10 "	3
11–15 "	2
16–21 "	1
26–30 "	1
31–40 "	0
41–50 "	3
51–60 "	1
Total	15

Table xxxvii
ANNUAL AND TOTAL MORTALITY

Year	No. Patients	Per Cent (Annual Mortality)
1921–25	1	20
1926–30	4	13.3
1931–35	4	9.1
1936–40	6	6.8
Total mortality 9%		

The causes of death are summarized in Table xxxv. Cardiac failure was the most frequent course of exitus and wound hemorrhage occurred next in frequency. The deaths occurring from wound hemorrhage occurred before vitamin K was used in this hospital. Of the fifteen hospital deaths, nine of them occurred before the fifteenth postoperative day.

Annual and Total Mortality. Table xxxvii is of particular significance because it shows marked and progressive improvement in our mortality figures. The total mortality compares favorably with that of Frank Glenn[2] who reports a mortality of 12.5 per cent in 112 patients with non-malignant disease on whom the common duct was explored at operation. Thirty-eight per cent of the patients in our series were not considered good risk patients. This must have a direct bearing on our operative mortality.

CONCLUSIONS

One hundred sixty-five cases in which the common duct was explored at operation have been reviewed.

The hospital mortality has been reduced one-third of what it was twenty years ago; nevertheless exploration of the common duct still carries a higher mortality than simple cholecystectomy and should be resorted to only when there is a definite indication of common duct disorders.

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COMPLICATIONS OF THYROID SURGERY*

ANATOMY OF THE RECURRENT LARYNGEAL NERVE, MIDDLE THYROID VEIN AND INFERIOR THYROID ARTERY

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THE most trying and serious complications resulting from thyroid surgery are mainly crisis, paralysis of the recurrent laryngeal nerves and hemorrhage. Since crisis is not directly due to the anatomical relationship of these structures, we are principally concerned with the anatomy as it regards the remaining two, namely, recurrent laryngeal nerve paralysis and hemorrhage.

The occurrence of unilateral injury of the recurrent laryngeal nerve may be distressing and at times alarming, but the symptoms resulting from bilateral injury assume serious proportions. Fortunately, however, the frequency of this complication is diminishing as the years pass and the percentage of injuries has been reduced from approximately 32 per cent in Bilroth's series as reported by Crotti[1] to a low series of 1½ per cent as reported by Lahey.[2] The frequency of occurrence of this accident depends to a certain extent upon how diligently one searches for the unilateral injury. There is no doubt that it occurs much more commonly than is reported in the literature.

Lahey[2] attributes his low incidence to the fact that he dissects out the nerve, deliberately exposing same, to avoid injury before resecting the gland. Prioleau,[3] on the other hand, states, "It is an axiom in thyroid surgery that a recurrent laryngeal nerve seen is injured." Here we have diametrically opposed statements with the preponderance of evidence being against the latter view, for the end result of any surgical procedure depends upon a good exposure and a thorough knowledge of the anatomy involved.

Many operators are under the impression that the most dangerous area for injury to the recurrent laryngeal nerve is the region of the inferior pole. This is quite erroneous for a review of the studies completed on the anatomical relationship of these structures finds the inferior pole in an area in which the recurrent laryngeal nerve would be least likely to be injured. From our studies it appears that the inferior thyroid veins can be ligated with safety at their point of exit from the gland.

Fowler and Hansen[4] were greatly impressed by the fact that in the large majority of the cases the most intimate relation between the gland and the nerve was not at the lower pole as is generally assumed, but rather on the posterior lateral surface, at the junction of the middle and lower thirds of the organ, at or just above the point where the chief branches of the inferior thyroid artery enter the gland.

Rodgers[5] states that the point of entrance of the recurrent laryngeal nerve corresponds to a point at or a little above the junction of the upper two-thirds with the lower one-third of the outer border of the lobe, but is on the posterior surface.

As a result of our studies based on one hundred dissections we most heartily concur with the above statements and are of the opinion that the point of entrance

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FIG. 1. FIG. 2.

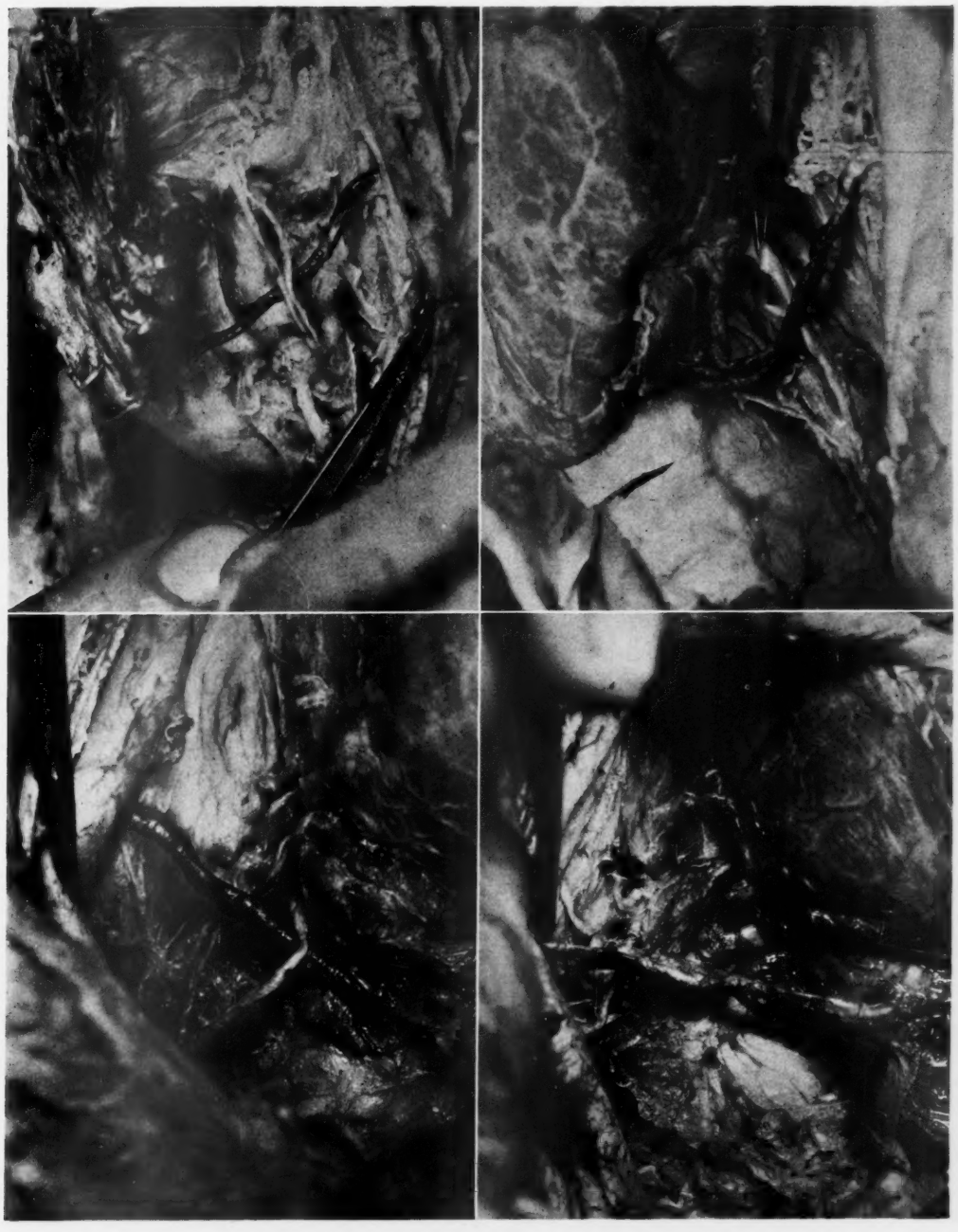

FIG. 3. FIG. 4.

FIG. 1. Descending inferior thyroid artery. Recurrent laryngeal nerve split passing anterior to the inferior thyroid artery. Medium sized v. Middle thyroid branch of the inferior thyroid artery is as large as the continuation of the vessel.

FIG. 2. Descending inferior thyroid artery. Medium sized double v. Nerve posterior to vessels. Middle thyroid branch of inferior thyroid artery is about equal in size to the continuation of the vessel.

FIG. Descending inferior thyroid artery. Medium sized v. Nerve passes through v. Middle thyroid branch of inferior thyroid artery is equal in size to the continuation of the vessel.

FIG. 4. Showing a large middle thyroid vein.

of the middle thyroid branch of the inferior thyroid artery and site of exit of the middle thyroid vein present one of the most constant glandular landmarks in thyroid surgery. It is with rare exception that these landmarks were not well defined, being located at the point of junction of the middle one-third of the gland with the lower one-third. The site of entrance of the middle thyroid branch of the inferior thyroid artery is at the posterior lateral surface and the point of exit for the middle thyroid vein is at approximately the same level but more anterior. It is at this level that the nerve approximates the gland, being in relationship with the posterior capsule.

Without exception the nerves passed posterior to the middle thyroid vein; and if the portion of the capsule which is to remain commences at this point, it is very unlikely that the nerve will be injured. However, the anatomy of the middle thyroid vein varies considerably not only in size but also in its termination. This variation will be discussed in another paragraph.

Too little stress is placed upon the thyroid branches of the inferior thyroid artery. Gray[6] states that the inferior thyroid artery divides into two branches which supply the posterior inferior part of the gland and anastomose with the superior thyroid artery and the corresponding artery of the opposite side. Callander[7] makes no particular mention of the terminal branches of the inferior thyroid artery, but an illustration beautifully depicts the inferior thyroid artery dividing into two main divisions before beginning its ramifications and divisions on the gland capsule. This branch which frequently was the principal vessel was absent but three times in the one hundred necks studied and often was considerably larger than the continuation of the inferior thyroid artery which enters the inferior pole of the lobe. This vessel which should definitely be called the middle thyroid branch or the middle thyroid artery enters the gland in relation to, or posterior to, the point of emergence of the middle thyroid vein and can be considered as constant as the inferior thyroid artery itself.

Hertzler[8] mentions the presence of a small artery in connection with the middle thyroid vein and also mentions the middle thyroid branch of the inferior thyroid artery which can be identified just lateral to the trachea and about one-half the distance between the two poles.

The inferior thyroid artery which it is presumed follows a transverse course from behind the carotid sheath, is a descending artery forming a loop; the superior or convex level frequently is on the same level as the point of entrance of the superior thyroid artery. This vessel with but few exceptions divides into two main branches forming the so-called v. This division may occur at any point after its emergence from behind the carotid sheath up to the capsule of the gland itself, the most usual point of this division being about 1 or 2 cm. from its point of entrance into the lobe.

The course of the recurrent laryngeal nerve in its relationship to this v has been frequently described. Nordland[9] describes the following:

	Right Side	Left Side
Nerve anterior	15	11
Nerve posterior	8	11
Nerve through v	7	7
Inferior thyroid artery absent	1	2 Nerve branched around artery

Berlin's description of this relationship is as follows:

	Right	Percentage	Left	Percentage
Posterior to artery	31	44	44	63
Anterior to artery	28	40	17	24
Through v	11	16	9	13

In our own dissections we have found the following:

	Right	Percentage	Left	Percentage
Posterior to artery	33	33	55	55
Anterior to artery	18	18	11	11
Through v	48	48	33	33
Split around artery	1	1	1	1

We are likewise of the opinion that the middle thyroid vein is frequently the source of troublesome bleeding and has been given insufficient attention. Gray[6] states, "The middle thyroid vein collects the blood from the lower part of the lateral lobe of the thyroid gland and after being joined by some veins from the larynx and trachea terminates in the lower part of the internal jugular vein. Often in the place of the middle thyroid veins there are two veins the superior and inferior assessory thyroid veins. These veins pass into the internal jugular."

In our dissections the frequent absence of the middle thyroid veins that joined the internal jugular was noticed. In a little less than 50 per cent of necks examined the middle thyroid vein would join the inferior or the superior thyroid plexus. Apparently, these are the veins alluded to by Gray[6] under the name of assessory thyroid veins.

The middle thyroid vein varies greatly in size, being from less than a mm. in diameter to a regular venous reservoir over 1 cm. in diameter. Many operators have the habit of freeing the gland from its bed by inserting the finger between the gland and its areolar coating and stripping the gland from its surrounding structures. This procedure must be very carefully carried out for one can readily see how easily it would be to overlook the middle thyroid vein, tearing same, with resulting troublesome hemorrhage. This accident is not liable to occur if the middle thyroid vein enters either the inferior or superior thyroid plexus of veins.

From the data here presented we are of the opinion that the most vulnerable area for injury to the recurrent laryngeal nerve and the most vulnerable site for hemorrhage is at the lateral posterior surface of the gland at the point of junction of the upper two-thirds with the lower one-third; for it is in this area that the middle thyroid artery enters the gland, the middle thyroid vein emerges from the gland, and the recurrent laryngeal nerve reaches the posterior surface of the gland, being in intimate relationship with the arterial vessels in this area.

One can readily see, how the presence of the recurrent laryngeal nerve anterior to the inferior thyroid artery and its middle thyroid branch in the presence of hemorrhage, would be quite likely to injury while attempting to control the bleeding; less likely to injury is the nerve when it passes through the v and least likely to injury if it is posterior to the arterial vessels.

CONCLUSIONS

1. The most vulnerable area of injury to the recurrent laryngeal nerve lies on the posterior lateral side of the gland at the point of junction of the middle one-third with its lower one-third.

2. The most probable source of hemorrhage is in this same area.

3. Attempt to control hemorrhage in this area is probably the cause of injury to the recurrent laryngeal nerve.

4. Thorough study of the anatomy in this area will tend to reduce the number of surgical complications and produce better end results, in that the surgeon will not remain too timid and remove sufficient portion of the gland to prevent a recurrence.

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There are two points of particular importance. First, where there is severe comminution, fragments of the patella must be removed and particular attention be paid to repair of the quadriceps tendon. Second, there must be careful plastic repair of the lateral ligaments not only from front to back but extending down on both sides of the knee from the point of the patellar fracture.

COMPLETE RECONSTRUCTION OF AURICLE

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DUE to the high percentage of war injuries which occur about the head, loss of the external ear has become a more frequent occurrence. Loss of an auricle produces a psychic effect on the individual just as much as any other deformity and, therefore, should be accorded equal attention in reconstructive surgery. To avoid prolonged hospitalization and unnecessary loss of time, the author has modified the existing technics of reconstructing an auricle and reduced the operation to two stages.

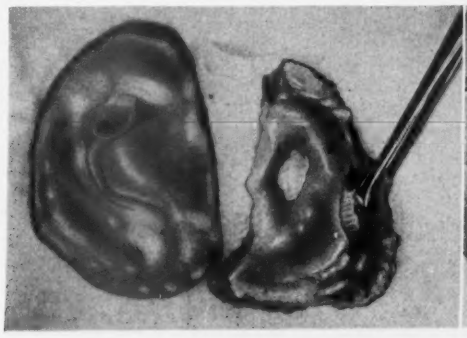


FIG. 1. Section of cartilage to be used as supporting framework of the auricle is removed from the seventh, eighth and ninth ribs.

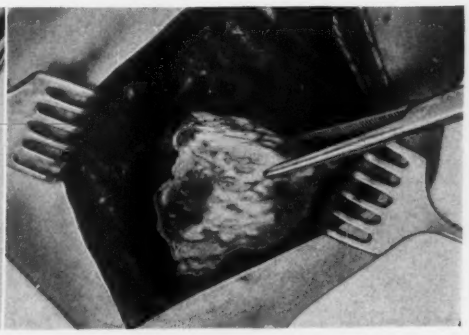


FIG. 2. Cartilage graft carved to mirror image of model of opposite ear.

OPERATION

Before the complete reconstruction is undertaken, the traumatic area must be free from any infection and completely healed. Also, if there are any remaining sections of cartilage or skin over the site of the auricle they should be removed and discarded.

First Stage. A preoperative model made of the patient's normal ear is reversed and placed along the temporomandibular region above and behind the external acoustic meatus, corresponding to the position of the auricle on the opposite side. With brilliant green dye, a line is drawn circumscribing the margin of the model to delineate the location of the future auricle. An incision is made through the skin over the marking and a flap is lifted from the cranial periosteum up to the external auditory canal.

The necessary large section of cartilage for the supporting framework of the auricle is acquired as follows: The cartilage is exposed through a vertical incision 10 cm. long and 5 cm. from the midsternal line so that the middle of the incision is over the seventh costal cartilage. The incision is deepened to the rectus muscle which is separated in the direction of its fibers and the seventh, eighth and ninth costal cartilages are exposed at their sternal junction. The model ear is placed on the exposed cartilage and outlined with a knife on the perichondrium. By means of a raspatory, the perichondrium is undermined around and under the surface of the ribs for the desired distance. The ends of the cartilage are cut through by cartilage shears and the section of cartilage is removed. (Fig. 1.) Severed vessels are clamped and ligated and towels are adjusted to the wound edges

by towel clips. The chest wound is closed in layers, a small rubber drain is inserted, dry gauze dressing applied and strips of adhesive firmly placed over the chest.

Fig. 3. The shaped rib cartilage graft is implanted in the prepared pocket between the scalp and temporomandibular fascia. This cartilage gives the structural support to the auricle.

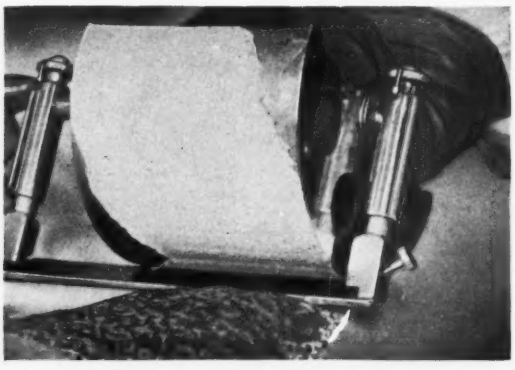


Fig. 4. A ¾ thickness skin graft is removed from the inner side of the thigh with the dermatome. The graft is 0.020 of an inch thick and 4 by 8 inches in size.

The remaining perichondrium is completely stripped from the graft and the preoperative model made of the opposite ear is used as a guide in molding on the cartilage graft, the structural convolutions forming the helix, antihelix and concha. (Fig. 2.) The graft is then inserted into the prepared pocket between the scalp and the temporomandibular fascia (Fig. 3) and the skin above it is sutured under tension by interrupted silk sutures. By means of a stent mold, the skin is pressed

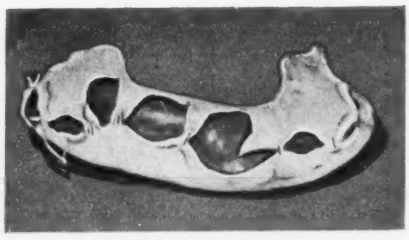


Fig. 5. Skin graft for covering raw surfaces is wrapped over stent mold.

from without into the convolutions of the new auricular cartilage and a snug mastoid bandage applied for ten days.

Second Stage Four Weeks Later. A semilunar incision 1½ cm. posterior to the proposed helix is carried through the temporomandibular fascia. The skin-cartilage flap is raised as far as the external acoustic meatus, care being taken not to cut into or expose the cartilage. The raised flap is now larger than the desired ear, due to the excess skin to be used for construction of the helix. The skin of the flap is undermined to a distance of 2 cm. from its external margin. This loose flap is curled and sutured on itself at the rim of the implanted cartilage to form the shape of the helix corresponding to that of the model ear. This produces a helix and lobule shaped according to the opposite ear. The amount of skin necessary to cover the surface area behind the new ear is marked on transparent lint. This pattern is placed over the thigh and a ¾ thickness skin graft, 0.020 of an inch in thickness, is obtained by the dermatome. (Fig. 4.) The skin, with the raw surface exposed, is wrapped over the stent mold modelled to fit the angle of protrusion of the normal ear, and held in place by sutures crossed above the stent mold at appropriate points. (Fig. 5.) The skin-cartilage flap with the helix completed looks exactly like the normal ear except for the lack of the posterior covering of the skin of the ear and the

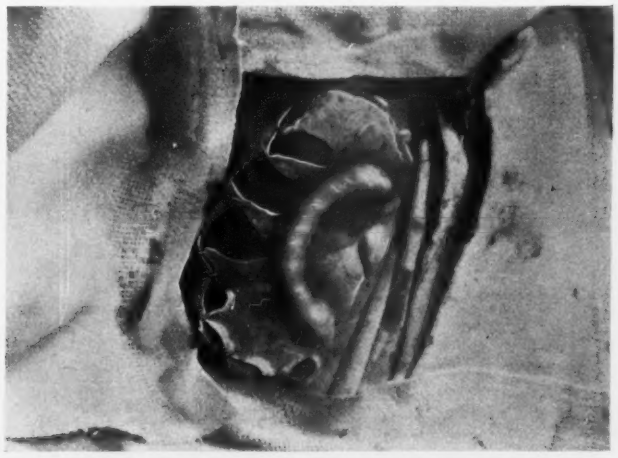
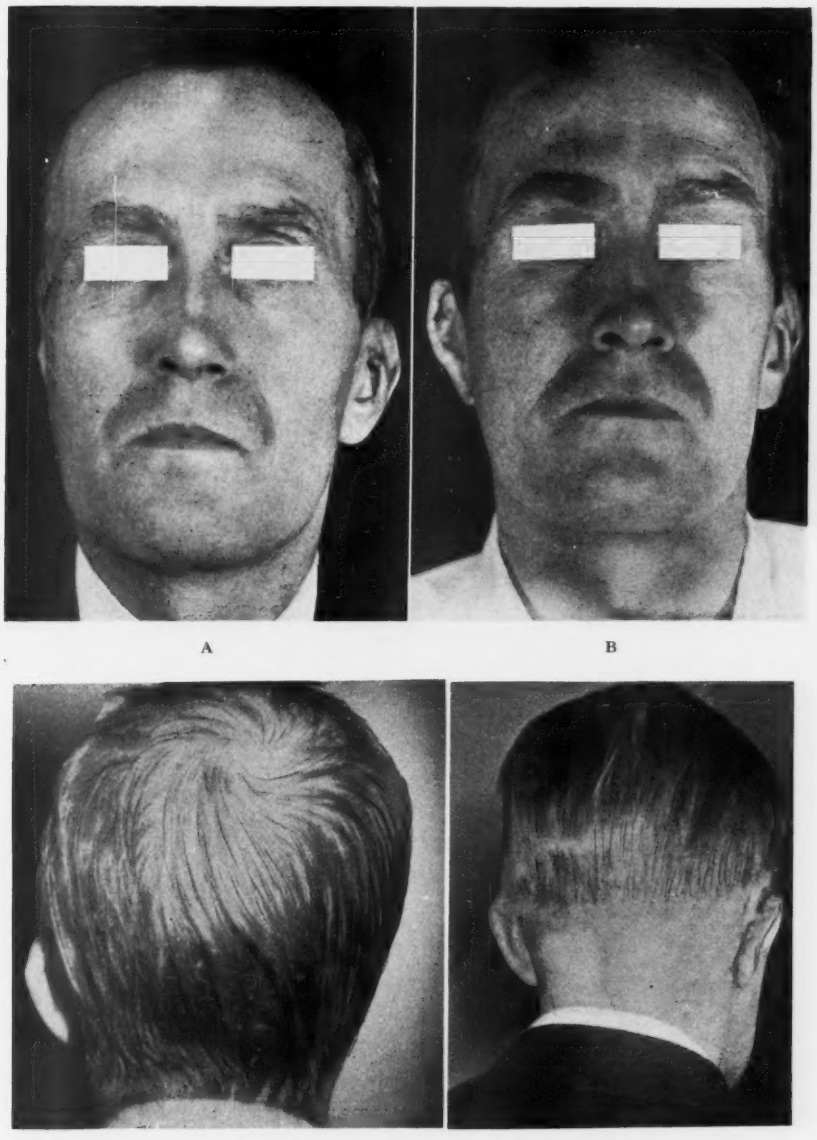


FIG. 6. Skin graft, wrapped in stent mold, is placed behind ear to cover defect area.



A B C D

FIG. 7. Reconstruction of auricle following total loss due to trauma.

periosteal raw surface of the cranium. The stent mold, wrapped in the skin, is then placed under the prepared flap and pressed into the convolutions in order to favor the take. (Fig. 6.) The skin over the stent mold is approximated by means of interrupted silk sutures to the posterior margins of the newly formed helix and also to the skin borders along the neck. A firm mastoid dressing is applied over the ear for immobilization. After ten days, the exposed excess skin over the stent mold, which is now parchment-like, is trimmed and the stent mold is removed, thus leaving the back of the auricle and the neck lined with a ¾ thickness skin graft. The completed auricle now assumes its normal shape and position at the side of the head. (Fig. 7.)

SUMMARY

1. The operation is reduced to two stages.

2. Hospitalization has been reduced to a minimum of one week for the first stage and five days for the second stage with an interval of one month between the stages.

3. The use of the preoperative model and the stents aids in producing an auricle which is normal in size, the convolutions of helix, antihelix and concha corresponding to the opposite ear.

4. Inasmuch as the loss of an auricle is usually accompanied by other facial or body injuries, the reconstruction can be undertaken during the convalescent period and therefore does not incapacitate the individual for an additional length of time.

In corrective operations for failure of union in fractures of the upper third of the humerus or femur, as in early fractures in these regions, special pains must be taken to immobilize the entire region of the shoulder and the hip. This is necessary both on account of the fracture itself and because of the danger of irritation, especially in the skin about the pin in the proximal fragment.

SULFATHIAZOLE ANURIA CURED BY DECAPSULATION OF THE KIDNEYS

CASE REPORT

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THIS report is concerned with two aspects of sulfathiazole treatment; (1) a singular type of renal disorder caused by sulfathiazole, a sulfonamide which uncommonly produces anuria, and (2) the value of kidney decapsulation, a procedure the merit of which has been repeatedly questioned.

Since Antopol and Robinson,[1] Gross, Cooper, and Lewis,[2] and Toomey[3] have reported their experimental work showing the renal pathological condition produced in certain animals given sulfapyridine, physicians have been more careful in the use of the drug. In their animal work, sulfapyridine concretions were found throughout the kidney tubules, pelves, and ureters producing a complete urinary obstruction. Southworth and Cooke's[4] early publication of the symptom complex of hematuria, abdominal pain, and nitrogen retention associated with sulfapyridine ingestion made clinicians alert for clinical signs which might indicate that the use of sulfonamides should be discontinued. It is now known that any patient taking a sulfonamide should have frequent urine examinations as well as blood studies. On the appearance of a microscopic hematuria a careful vigilance must be kept; and should the hematuria become progressively worse and a macroscopic hematuria develop, the drug must be discontinued. There may be no hematuria but only an oliguria and later an anuria, making it quite important to watch the fluid intake and output.

This experimental work on sulfapyridine has been substantiated clinically in the writings of Carroll, Shea, and Pike,[5] Plummer and McClellan,[6] and Sadusk and Waters.[7] Winsor and Burch[8] have pointed out the great importance of cystoscopy, ureteral catheterization, and irrigation of the kidney pelves with warm boric acid solution, saline, or distilled water.

Our purpose in presenting this material is to show (1) that acute sulfathiazole anuria may be due to a pathological reaction within the kidney parenchyma only; (2) that this anuria cannot be relieved by cystoscopy, ureteral catheterization and irrigation, and forcing intravenous fluids; (3) that kidney decapsulation may alleviate this condition; and (4) the renal disturbance in sulfathiazole anuria by a kidney biopsy, the first case reported to our knowledge.

CASE REPORT

Mr. H. P., a white, thirty-nine year old traffic manager, was admitted to the Chicago Memorial Hospital December 3, 1941. Discharged from hospital December 23, 1941. His chief complaints were vomiting, epigastric distress, subconjunctival hemorrhages and hiccoughs, all lasting four days.

The patient, a chronic alcoholic, consuming approximately a pint of liquor (whiskey) a day, felt "quite well" up to four to five weeks before hospitalization. After a debauch at that time, he developed a cold and cervical lymphadenopathy which were treated with sulfathiazole (9 Gm. in three days) and cough medicine. Apparently he recovered. Four days prior to entering the hospital, he awoke and could not stand even the odor of food. He began vomiting, at first mucus and later colorless, cloudy liquid which he was still vomiting when hospitalized. Each spell of vomiting was preceded and followed by a distressing attack of hiccoughs.

The patient had the feeling of a lump in his midepigastrium. His eyes were red in spots, and the "whites" of his eyes yellow. He ached all over.

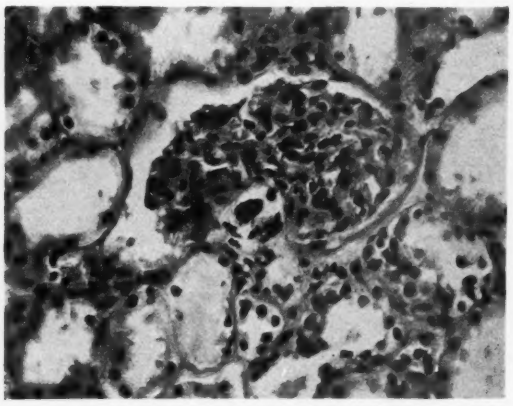

Fig. 1. Calcified calculus (sulfathiazole) at hilus of glomerular tuft (hematoxylin-eosin preparation).

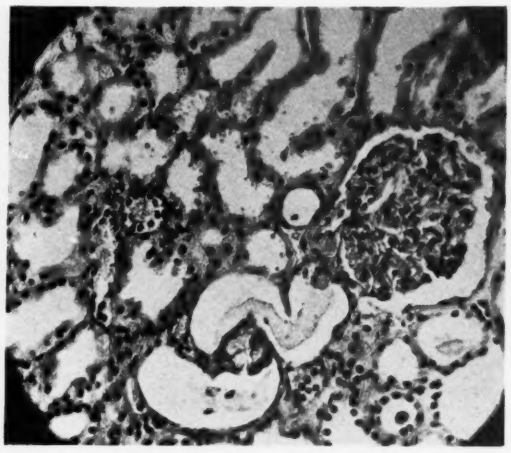

Fig. 2. Noncalcified calculus between dilated tubules (hematoxylin-eosin preparation).

The cardiorespiratory examination was negative. Gastrointestinal findings were vomiting and clay-colored stools. The urine was of a dark brown color preceding any previous recent medication (such as sulfathiazole); otherwise it was negative. Oliguria was present since onset of illness, i.e., four days before hospitalization. The neuromuscular examination was negative. He had had a gallbladder attack four years previous and whooping cough during childhood and tonsillectomy. Twelve years previous, he was in an accident in which head injury was sustained with a short period of unconsciousness.

Physical examination revealed the following: Pulse 72, temperature 97°F. respiration 18, weight 145 pounds. His skin and head (except eyes) were negative. His eyes revealed conjunctival hemorrhages; icteric sclerae. The thyroid and lymph-nodes did not enlarge to palpation. His chest was negative; blood pressure 115/70, rhythm regular, tones distant, no murmurs were heard. The lungs were clear and resonant. The abdomen was soft and round. Liver, kidneys, and spleen were not palpable. Rectal examination, bones, joints and extremities were all negative.

From December 3, the day of admission, to December 7, the patient received 1,000 cc. of 20 per cent glucose daily, intravenously, and took from 12 to 30 ounces of liquid by mouth. His urinary output was only 1½ to 4½ ounces per twenty-four hours and the blood nonprotein nitrogen was 115 mg. by December 6. On that day he was seen in consultation by Dr. Louis Leiter, who made a diagnosis of acute toxic hepatitis complicated, possibly, by an acute diffuse glomerulonephritis initiated by the upper respiratory infection of the previous month. Sulfathiazole was considered as a factor in the oliguria but was excluded on the basis of the time elapsed since its administration, the absence of pain along the urinary tract, and the absence of gross hematuria. The amount of parenteral fluids in the form of 5 or 10 per cent glucose and isotonic saline was increased. We decided to do cystoscopy and ureteral catheterization within twenty-four hours if the patient's urine volume did not increase promptly. On December 7, when cystoscopy revealed no obstruction below the kidneys and severe oliguria was persisting, Dr. Leiter was again consulted and a diagnosis of intrarenal edema or acute interstitial inflammation was made. We discussed the advisability of renal decapsulation in the event of continued failure of the patient to respond to diuretic measures. In the next forty-eight hours, the daily urine volume was 6½ ounces and the specific gravity 1.008 to 1.011. The blood nonprotein nitrogen rose to 164 mg. and the creatinine to 21 mg. The patient was definitely getting worse, with periods of disorientation, oppression in the chest, some fluid in the abdomen, and a very tender liver. Decapsulation was decided upon after consultation with Dr. V. J. O'Conor, who stated that while there was little to expect from decapsulation, it was the only hope in sight. He recommended complete bilateral decapsulation under spinal

and gas-oxygen anesthesia, adequate drainage of the perirenal areas, and transfusion of plasma if serous drainage was profuse. The operation was carried out at 11 P.M. on December 9.

The anesthetic used was novocaine, 200 mg. in 3 cc. spinal fluid and ethylene. The following procedure was performed on each kidney: A Mayo incision (loin) was made through the skin, the fascia, the latissimus dorsi, and external and internal oblique muscles. The perirenal fat was incised and retracted and the kidney isolated. The capsule was smooth and glistening, and the kidney about 20 per cent enlarged. The capsule was incised on its convex curvature from pole to pole, and the kidney cortex was seen to "puff out" under the tight capsule. The capsule, which stripped easily, was stripped to either side and backward toward vessels. The kidney surface was greyish red with no petechiae. A hard round rubber tube was placed in the kidney bed and drain brought through one corner of incision and Penrose drain placed and brought out through the other. The entire abdominal incision was closed with interrupted silkworm sutures. Hemostasis was good. The pathological condition was severe congestion of kidneys. A biopsy was taken for microscopic study.

The microscopic study revealed the following: In a wedge-shaped section through the periphery of the kidney, the cortical tubuli were lined by swollen, frayed, and vacuolated cells. Within their lumina were desquamated epithelial cells, occasional red blood cells, basophilic and eosinophilic casts, and circumscribed, basophilic concretions. The glomeruli were occasionally hyalinized. At the hilus of some, concretions were noted. With the Von Kossa stain, these concretions were black (calcium).

The first few days were followed by a general improvement, as evidenced by the blood chemistry and blood pressure. There was a fair amount of drainage from the wounds, which subsided after the first five or six days. The temperature curve was never higher than 102°F. Otherwise, the course was uneventful and the patient was discharged recovered.

COMMENT

It is becoming more evident that the formation of urinary sulfonamide calculi has little to do with a lowered hydrogen ion concentration of the urine; nor can this be prevented or corrected by alkalinization.[9] Forcing fluids to decrease the concentration of the drug is important. Urinary concretions alone cannot be the reason that sulfonamide calculi form, for these occur in some patients who receive very small doses of the drug and who apparently are not dehydrated. On the other hand, patients may receive huge doses of the drug and no concretions form. It would seem more likely that some patients have a tendency to develop sulfonamide calculi just as some individuals acquire the ordinary urinary tract stones. The usual urinary calculi are formed over a long period of time, while sulfonamide calculi are formed rather suddenly. It would be interesting to check these patients for a history of previous stones and to follow them up to see whether other types of urinary stones are formed later. It is possible that some have what is analogous to a renal idiosyncrasy for the drug. This is suggested by the formation of calculi after small doses. This seems to be true for sulfapyridine, sulfathiazole, and sulfadiazine, which may produce sufficient renal damage to cause hematuria, oliguria, and/or anuria and death.[9]

FIG. 3. Note calcified calculus against wall of tubule, with desquamated epithelial cells and leukocytes within lumen. Smaller calculus in another tubule (hematoxylin-eosin preparation).

The most interesting feature in this case report is that no concretions were formed in the kidney pelves, ureters, or urinary

bladder, but only within the kidney tubules. Utilizing the concept of Winton,[10] the pathological physiology resulting from this renal damage perhaps was as follows: The concretions formed within the tubules produced a dilatation of the tubules, cloudy swelling of their lining cells, and some interstitial edema. This increased the intrarenal pressure and the latter along with the dilated tubules caused a partial venous obstruction, congestion of the kidneys, diminished blood flow and oliguria. Winton[11] states that the increased intrarenal pressure associated with edema or engorgement may be an important factor in producing the oliguria which occurs in certain diseased conditions of the kidneys. Experimental work by Morison[12] shows that when there is a urinary obstruction producing hydronephrosis and damage to the tubules, the entire glomerular filtrate may be reabsorbed. The same principle could apply in intrarenal or intratubular obstruction. It is likely that the high in-

BLOOD

Date	12-3-1941	12-6-1941	12-8-1941	12-10-1941	12-11-1941	12-13-1941	12-15-1941
Red blood cells per c.mm	3,860,000	3,920,000	3,700,000	4,110,000	.....	4,030,000	4,030,000
Hemoglobin	78%	78%	74%	78%	.....	81%	76%
White blood cells per c.mm	11,100	12,200	11,800	15,000	.....	15,100	12,900
Neutrophiles	92%	74%	74%	85%	.....	84%	80%
Eosinophiles	1%	1%					
Small and large lymphocytes	7%	18%	24%	12%	.....	14%	19%
Monocytes	.....	7%	2%	3%	.....	2%	1%
Coagulation time	.....	.....	.....	.....	1 Minute		
Blood pressure	12-9-1941 140/70	12-10-1941 140/88	12-11-1941 140/72	12-12-1941 135/80	.....	12-15-1941 128/54	12-16-1941 120/58

BLOOD CHEMISTRY

Date	12-3-1941	12-6-1941	12-9-1941	12-11-1941	12-13-1941	12-19-1941
Icterus index	16 units					
Nonprotein nitrogen	.....	115 mg. per 100 cc.	164 mg. per 100 cc.	142 mg. per 100 cc.	103 mg. per 100 cc.	37 mg. per 100 cc.
Creatinine	.....	.....	21.4 mg. per 100 cc.	.....	.....	1.9 mg. per 100 cc.
Chlorides as NaCl	.....	.....	Serum chloride 550 mg. per 100 cc.			
Plasma cholesterol	.....	.....	.....	Total cholesterol, 100 mg. per 100 cc. serum. % Esters, 58		

12-11-1941	Patient's prothrombin time, 20.5 seconds; control, 18 seconds.
12-12-1941	Patient's prothrombin time, 19 seconds; control 17 seconds.

Wassermann and Kahn—Negative.

Date (1941)	Fluid Intake, 24-hour Amount, (Cc.)	Urine										
		24-hr. Amt., (Cc.)	Color	Reaction	Sp. Gr.	Albumin, (Mg.)	Microscopic					
							Casts	Blood Cells	Pus Cells	Crystals	Ep. Cells	Bact.
12-4	1360	135	Dark, turbid	Acid	Q.N.S.	100	Occ. granular	10–12	10–15	Urates	Mod.	
12-5	2000	45	" "	Acid	Q.N.S.	100	Occ. granular	10–20	Occ.			
12-6	3000	75	" "	Acid	Q.N.S.							
12-7	2200	150	Yellow, cloudy	Acid	1.011	Loaded	Coarse granular, loaded					
12-8	2800	120	Bloody	Alk.	1.012	.....	.....	.....	Many			
12-9	2100	0	Bloody	Alk.	1.008	.....	Large granular	.....	.....	.....	....	Bact.
		(Operation, 11 P.M.)										
12-10	2750	870	Yellow, clear	Alk.	1.010	100	Few granular	75–100	10–20			
12-11	2100	800	Yellow, sl. turb.	Acid	1.013	75	Occ. granular	75–100	4–6	.....	....	Bact.
12-12	2440	2880	Yellow, clear	Alk.	1.010	30	Few granular	25–50				
12-13	3600	3870	Straw, clear	Acid	1.010	10	Occ. granular	10–15	3–5			
12-14	3420	3300	Straw, clear	Acid	1.010	15	Occ. granular	10–15				
12-15	3200	2580	Yellow, clear	Acid	1.012	10	Occ. granular	6–8	10–15			
12-16	2760	2160	" "	Alk.	1.010	20	.....	3–5	5–10			
12-17	3420	1800	" "	Acid	1.013	20	Mod. granular	10–20	25–50			
12-18	3030	1650	" "	Alk.	1.010	0	Many granular	5–10	10–20			
12-19	2580	1530	" "	Acid	1.014	10	Mod. granular	3–4	10–15			
12-20	2640	1500	Amber, clear	Alk.	1.012	20	Few granular	Occ.	10–15			
12-21	3060	1380	Amber, clear	Acid	1.018	10	Many hyaline granular and cellular, bile-stained	0	10 Occ. clumps			
12-22	3060	930	Yellow, clear	Alk.	1.012	0	.....	0	5–10			
12-23	3000	1620	" "	Alk.	1.012	0	Mod. granular	Rare	10–12			
		12-4 to 12-23, incl: Sugar and/or Acetone: 0										

CYSTOSCOPIC

Date	Bladder	Urine	Ureteral Orifices	Function
12-7-1941	Normal	Straw-colored	Both normal	Poor. Few drops urine.
12-7-1941	Indigocarmine test: No dye in 20 minutes.			

trarenal pressure present in this case, as evidenced by the marked bulging of the kidneys after decapsulation, is the explanation for the cause of the anuria. After the kidney damage has reached a certain point and the intrarenal pressure has been elevated, the process may become irreversible and no amount of parenteral fluids will rectify the condition.

Antopol and Robinson[1] offer experimental data on animals suggesting that the obstructing crystalline mass can be dissolved or washed out. They suggest also the possibility that a certain amount of kidney damage precedes the formation of concretions within the kidneys. The microscopic study of the cortical biopsy in our patient substantiates the latter possibility, for there was a distinct disproportion between the small number of concretions present and the complete anuria which resulted. It may be that many of the larger collecting tubules within the pyramids were obstructed but were not seen in this biopsy of the cortex. Since the tissue was stained with hematoxylin and eosin, it is also likely that many of the concretions and casts were washed out of the section.

It is conceivable that severe oliguria may occur as a result of tubular degeneration caused by the sulfonamide drug with little or no associated calculous formation.[13] This condition would be analogous to findings in cases of post-transfusion anuria, in which the tubules do not contain obstructing casts.[14]

Decapsulation of the kidneys was first performed by Reginald Harrison[15] in 1878 for acute nephritis following scarlet fever. This surgical procedure has been shown to be of considerable value[15] in certain acute kidney diseases which do not respond to medical treatment and are complicated by hematuria, oliguria, and anuria with a mounting nitrogen retention and impending death. The use of decapsulation for all forms of Bright's disease by Harrison, Edebohls, and Ronsing[15] gave such inconclusive results that the procedure was nearly abandoned. But it should be borne in mind that some acute kidney diseases such as acute nephritis following scarlet fever, acute suppurative nephritis, and mercurial nephrosis associated with oliguria and/or anuria and uremia may be cured by decapsulation of the kidneys.

A number of theories has been advanced for the beneficial effect of the operation in these cases. This report lends credence to the theory of Harrison[15] that the decapsulation simply released the great intrarenal pressure which, on the basis of the above physiological concept,[11] would be most responsible for the anuria.

In the case reported, there seems little doubt that the raised intrarenal pressure was relieved by decapsulation, for the kidneys bulged a great deal when they were decapsulated. The patient was almost completely anuretic for three days, getting progressively worse, and developing severe uremia before decapsulation was performed. He urinated shortly after the operation and began to improve, leaving little doubt that the operation was directly responsible for saving his life.

SUMMARY AND CONCLUSIONS

1. A case of anuria caused by sulfathiazole therapy is presented.
2. Anuria was due to concretions within the kidney tubules, which most likely caused a rise in intrarenal pressure and cessation of the flow of urine. Damage of tubular epithelium probably was a contributing factor.
3. Treatment by cystoscopy and ureteral catheterization is useless in this type of case, although it must be performed to exclude calculi in the pelves and ureters.
4. Bilateral kidney decapsulation is indicated in persistent sulfathiazole anuria when medical treatment fails.
5. The amount of renal damage seems less than that caused by sulfapyridine.
6. Microscopic hematuria and oliguria may be the only ominous signs in an impending sulfathiazole anuria.
7. Harrison's theory that the success of kidney decapsulation is based on the re-

lease of an increased intrarenal pressure receives further substantiation.

8. The pathological reaction of the kidney cortex produced by sulfathiazole is presented.

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TREATMENT OF SHOCK AND FRESH WOUNDS*

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NEVER was the need for a sound knowledge of the cardinal principles of the surgery of wound treatment greater than it is today. With practically the entire world at war and with a great burden resting upon our nation, it is necessary that we keep our soldiers at the front fit for fighting and our peoples in industry fit for production, especially since it is estimated that twenty persons in industry are required to care properly for the needs of one of our soldiers at the front.

It is, therefore, timely for us to discuss the treatment of wounds and of shock following trauma. Wounds comprise the greatest number of all accidents. An accident is something that nobody is ever prepared for; there is no prodromal period and, as a rule, it is associated with shock to a greater or lesser degree. The very young and the very old are easily shocked.

SHOCK

Shock is associated with circulatory breakdown. The circulation is dependent upon (1) peripheral-vascular resistance, (2) blood volume, and (3) action and force of the heart beat.

In shock, the peripheral resistance is lowered because of dilatation of the capillaries and, as a result of the stasis that follows, there is an exudation of plasma into the soft tissues. This loss of fluids diminishes the blood volume and the force of the venous return flow to the heart is greatly lessened, and so the force and action of the heart beat is greatly disturbed. With the plasma loss is associated a loss of proteins and a relative increase in the cellular content of the blood. Because of the sluggish circulation, there follows faulty oxygenation of the blood. With the protein loss, there is a change in the albumin-globulin ratio, because of the more rapid loss of albumin from the blood stream. An increase in the hematocrit reading is always seen with a loss of plasma. The viscosity of the blood is increased. Of course, when shock is due to hemorrhage, there is no change in the hematocrit reading and no change in the albumin-globulin ratio. Probably, the simplest way to differentiate between shock due to hemorrhage and that due to loss of plasma is by a simple blood count. In hemorrhage, the red blood cells and hemoglobin rapidly go down; while in shock due to loss of plasma, the red count and hemoglobin are increased. A fall in blood pressure follows shock, but it does not initiate shock.

The causes of shock are pain, cold hemorrhage, toxemia, cerebrospinal damage, and injuries. The signs of shock are restlessness, pallor, thirst, rapid pulse, cold clammy skin, vertigo, superficial rapid respirations and air hunger, and vary depending upon the causative factor.

Primary shock occurs immediately following an injury. It may be a temporary circulatory disturbance of vasomotor origin. Secondary shock comes on some time after injury and may be the result of faulty treatment or infection.

TREATMENT OF SHOCK

The most important treatment is prevention. Control of bleeding must have priority over all else. An injured person should be relieved of pain and anxiety by proper sedation. He should be kept warm by the use of blankets, hot water bottles, heat lamps, etc. If there is bleeding, it

* Read before the Lehigh Valley Medical Society, Allentown, Pennsylvania, the American-Hungarian Medical Association, New York City, and the Rockaway Medical Society, Lawrence, Long Island.

should be immediately controlled. The foot of the bed should be elevated.

If there is a wound, it should be properly protected and fractures should be splinted.

When shock occurs, fluids must be given by every avenue; namely, via the veins, skin, rectum and mouth. Glucose, 5 per cent in normal saline, is probably the easiest to obtain and is readily given by vein.

If the shock is due to hemorrhage, a transfusion of whole blood is indicated. If it is due to loss of plasma, then an infusion of plasma should be given, 250 cc., 500 cc. or 1000 cc., depending upon the loss. Oxygen by the Boothby mask is of great value.

FRESH WOUNDS

In the treatment of fresh wounds, first control excessive bleeding; if possible, by clamping the blood vessels and tying. Mass ligation is frowned upon. Temporary moderate bleeding may help to flush foreign bodies from the wound.

Wounds are classified as, incised, punctured, lacerated, contused and abraded. The incised bleed most freely. The incised and abraded do not require débridement; the contused and lacerated do and the punctured may.

By fresh wound, we mean the wound seen within eight hours after the accident ("The Golden Period"). All wounds not made with surgical intent should be considered contaminated. We have, as yet, no antiseptic that will destroy all organisms without destroying living tissues. The sulfonamides are bacteria-static to a very great extent, but not absolute bacteriacides. Their use is urged; their great value has been proved.

A prophylactic injection of 1,500 units of tetanus antitoxin should be given immediately and carefully. Make sure that the patient is not sensitive to the antitoxin. Of course, when the wound has occurred in a bath tub or in a tile bath room or when it is the result of a clean instrument, such an injection may not be necessary. A second injection of 1,500 cc. of tetanus antitoxin should be given after one week and with the same care.

All wounds should be properly cleansed. If there is grease or grime about the wound, it should be temporarily packed with sterile gauze or closed with clips and the surrounding skin cleansed with a solvent, such as gasoline, benzine or kerosene and washed with plenty of warm water and soap and dried. The wound should then be opened, irrigated with copious quantities of warm normal saline, allowed to bleed gently and dried. Devitalized tissue will soon be evident by its lack of color, lack of bleeding and loss of elasticity. All devitalized tissue should then be excised and only normal tissue should be seen. All foreign material should be removed from the wound if readily reached. Following débridement, the wound is again irrigated with large quantities of saline. The wound is carefully inspected; any severed tendons and nerves are found and immediately repaired with silk sutures From 5 to 15 Gm. of sulfanilamide powder is then sprinkled into the wound so that no great amount of the powder is in any one area. The wound is loosely closed in anatomic layers; its edges gently approximated and with no tension. Every wound should be drained with rubber bands or rubber tissue for from twenty-four to forty-eight hours. Sulfonamides have been used. As a matter of fact, wounds may be allowed to remain open for twenty-four to forty-eight hours and, if no infection occurs, sutured. Primary union will follow.

There is much agitation against drainage, but I have seen no bad results therefrom, and union does occur by first intention. It is better than suturing immediately and having to remove sutures because of infection.

All wounds should be immobilized in the optimum position and the part elevated. Rest promotes healing and prevents re-infection. Infrequent dressings are urged.

Wounds of the pleura and of the peritoneum should be closed at once. The

tissues should be treated as described and the sulfonamides dusted into the pleura or peritoneum.

Punctured wounds with large underlying hematomas or associated with large subcutaneous damage should be enlarged, the bleeding stopped, the hematomas evacuated, and the wound packed with sulfanilamide and treated as described above.

CONCLUSIONS

1. There are two outstanding advances in the treatment of shock and wounds: (1) The use of blood plasma, which is now readily obtainable and requires no typing; (2) the use of the sulfonamides.

2. Control of hemorrhage takes priority over all other local treatments.

3. The treatment of primary shock and prevention of secondary shock are necessary before wound treatment.

4. Intravenous plasma infusion is the most important single item in the treatment of shock. The prompt, adequate and, if necessary, repeated infusion of plasma will restore the circulating blood volume, increase the venous pressure, increase the cardiac output, relieve capillary stasis and tissue anoxia and restore proteins.

5. Infection in fresh traumatic wounds is most effectively prevented by copious irrigation with warm normal saline solution followed by débridement and implantation of sulfanilamide or sulfathiazole powder.

6. The question of closure with or without drainage is dependent upon the length of exposure, the thoroughness of the débridement, and the experience of the surgeon. Delayed closure of all wounds, except of the pleura or peritoneum, is suggested.

Case Reports

SACROCOCCYGEAL CHORDOMA*

REPORT OF A CASE

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CHORDOMA was first reported by Müller[1] in 1858, and extensively studied anatomically, histologically, and experimentally by Ribbert[2] in 1894. Alezais and Peyron,[3] in 1914, demonstrated the histogenesis and evolution of the tumor. Since then comprehensive reviews of reported cases and further studies have been made by Stewart,[4] in 1922, Eckel and Jacobs,[5] in 1925, Coenen,[6] in 1925, Stewart and Morin,[7] in 1926, Capell,[8] in 1928, Grinda,[9] Machulko-Horbartzewitch and Rochlin,[10] Fletcher,[11] and Babrey,[12] in 1935. The latter found 150 cases of chordoma in the literature, distributed as follows: cranial, forty-nine; vertebral, fourteen; and sacrococcygeal, eighty-seven. Since then about thirty further cases of sacrococcygeal chordoma have been reported.

We present here a case of sacrococcygeal chordoma with the unusual complication of perforation into the peritoneal cavity.

CASE REPORT

The patient, a seventy-three-year old Italian male, was admitted to the Chicago State Hospital on May 5, 1938, as a case of psychosis with cerebral arteriosclerosis. For several years prior to admission the patient had episodes of depression, delusions of persecution, and violently jealous delusions concerning his wife. After an attack on her in which she sustained a skull fracture, the patient was committed to an institution.

Medical history obtained from the patient's relatives revealed that eleven years prior to his admission the patient had sustained an injury to the base of his spine. The region became very painful and an operation was performed in 1927, the nature of which is unknown. The pain recurred with increasingly severity and in 1934 the patient was again operated upon. A cystic tumor of the sacrum was evacuated and partially resected. Microscopically, the tumor was diagnosed a chordoma. The wound healed well and the patient remained fairly comfortable. In July, 1938, while a patient in the Chicago State Hospital, he was referred to the hospital ward because of persistent constipation. Proctoscopy, performed by Dr. Louis Block, revealed a posterior rectal mass, hard, and partially obliterating the lumen. *X*-ray (Fig. 1) revealed cystic degeneration of the sacrum with irregular areas of calcification. Because of the patient's advanced age and poor physical condition it was believed best to leave the tumor alone. The patient was examined at periodic intervals and the tumor appeared to be stationary.

On August 26, 1940, the patient was admitted to the hospital ward with abdominal cramps, mild distention, and a rectal temperature of 101°F. Physical examination revealed abdominal spasm, generalized tenderness to moderate palpation, and rebound tenderness. On the following day the patient became more distended, began vomiting, and Levine suction, intravenous fluids and sedation were instituted. Laparotomy was advised and performed by Dr. A. V. Partipilo, under ethylene-ether anesthesia. As the peritoneum was opened, a large amount of thick fecal-smelling fluid gushed forth. Because of the patient's poor physical

* From the Departments of Surgery and Pathology, Chicago State Hospital. † Since the submission of this article, both authors have joined the armed forces.

condition, three Penrose drains were inserted and the abdomen closed. The patient's course continued downhill and he expired on the day following surgery.

FIG. 1. *X*-ray of the sacrum, showing a cystic and moth-eaten appearance.

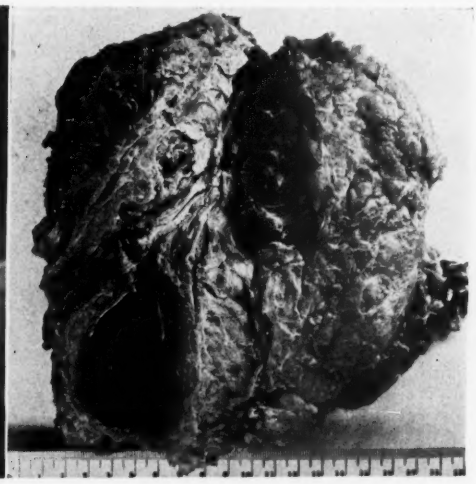

FIG. 2. Dorsal view of sacrum and subcutaneous connective tissue. The sacrum is almost completely replaced by tumor which also invades the subcutaneous tissue.

Postmortem examination revealed the body to be that of an emaciated white male about seventy years of age. Over the sacral region a moderately firm mass about 8 cm. in greatest diameter could be felt in the subcutaneous tissue. On section this mass was found to be continuous with tumor tissue which had replaced most of the sacrum (Fig. 2), pushed the rectum forward and enveloped it, as well as extended upward behind the sacrum. The peritoneum in this region was necrotic. The tumor tissue was in parts friable and in parts semifirm. The cut surface presented a mosaic of red and yellowish grey, glossy-looking areas. The tumor had perforated into the rectum in several regions so that a fistulous tract was formed between the rectum and the peritoneal cavity. The lining of the peritoneal cavity was dull and granular throughout. The loops of small intestine were mutually adherent although the loops separated with ease. Between these loops there were pockets of purulent material. The sigmoid colon, as it slipped down behind the urinary bladder produced a pocket of thick pus. The retroperitoneal tissue of the left gutter was dull reenish greay and purulent.

The heart presented an old infarct in the anterosuperior wall of the left ventricle with a corresponding mural thrombus and old pericarditis. The coronary arteries were markedly sclerotic with narrowing of the lumen of the ramus anterior descendens and the left circumflex branch. The lungs were the seat of edema. The liver and spleen were grossly not remarkable. The urinary tract showed an obstruction of the bladder neck, left hydroureter, acute ureteritis and pyelitis. There was a recent infarct in the right kidney.

Histologic examination of the tumor (Figs. 3 and 4) showed the following: hematoxylin and eosin, and van Giesen revealed irregular pockets of tumor tissue separated by trabecules of varying thickness. The tumor tissue varied in appearance as follows: (a) Some pockets consisted of well demarcated large cells which differed markedly in size and shape. The nuclei were irregular, some small, some large, with dense nuclear membranes and scant chromatin material. The arrangement of chromatin was such as to present a honeycombed or vacuolated appearance. No mitotic figures were noted. The cytoplasm was slightly basophilic, markedly vacuolated and varied in abundance, being in some cases moderate in amount, and in others very abundant. (b) Some pockets consisted of a sea of slightly basophilic staining homogeneous material in which were scattered poorly demarcated large cells. (c) Some pockets showed a periphery of relatively small and moderately sized cells. Internal to these were cells with more abundant vacuolated cytoplasm. The center of the pocket consisted of a pale blue staining material with scattered nuclei.

The nature of the trabeculas likewise varied. Very little collagen was found in some trabeculas with scattered connective tissue nuclei.

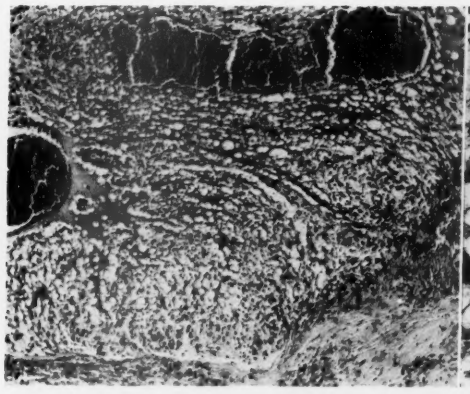

FIG. 3. A typical section of the tumor (hematoxylin and eosin preparation) × 64.

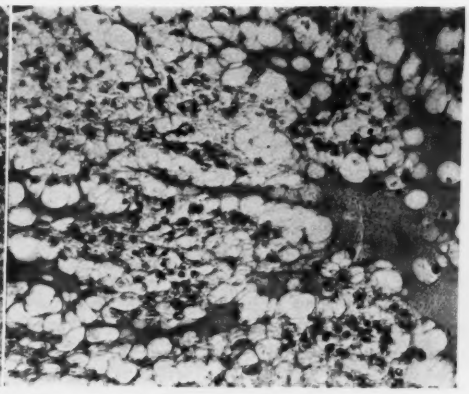

FIG. 4. Higher power of same section (hematoxylin and eosin preparation) × 240.

These trabeculas consisted mostly of eosinophilic amorphous material which stained yellow with van Giesons; other trabeculas consisted of collagenous connective tissue. Some trabeculas consisted of extravasated blood cells. In many cases the trabeculas were not sharply demarcated from the tumor tissue and seemed to be part and modification of the latter. Many widely dilated, thin-walled vascular channels were present in the trabeculas and within the tumor tissue proper.

The pathologic diagnosis was: (1) Chordoma of the sacrococcygeal region with invasion of the sacrum, the subcutaneous tissues over the sacrum, and the retroperitoneal tissue about the rectum and sigmoid; (2) acute and chronic inflammation of the retroperitoneal tissue; (3) perforation of the rectum; (4) acute suppurative peritonitis; (5) obstruction of the urinary bladder, left hydroureter, acute ureteritis, and pyelitis. There were incidental pathological conditions in many other organs.

COMMENT

From the clinical standpoint this case presented the unusual complication of involvement of the peritoneum with the production of acute peritonitis. Otherwise the usual symptoms and signs of a slow-growing sacrococcygeal chordoma with anterior and posterior extension were present: (1) severe pain in the sacral region, (2) palpation of a mass through the posterior wall of the rectum, (3) *x*-ray findings of destruction of the sacrum, and (4) constipation.

The history of injury in this patient is of interest. Babrey[12] found a history of trauma in 26 per cent of all sacrococcygeal cases, and Fletcher, Woltman, and Adson[13] found it is two of their ten cases. Trauma may thus be a factor in the production of chordoma in this region.

From the pathological standpoint, the tumor here presented is a relatively benign type of chordoma. There is a great deal of mucinous material, many physaliphorous cells, with a few compact small epithelium-like cells. No mitotic figures are present. These characteristics speak for relative benignity. The general histologic features of chordoma are (1) formation of intracellular and extracellular mucinous material and the presence of physaliphorous or highly vacuolated cells containing mucinous material, (2) the lobular or pocket arrangement of tumor cells, (3) vacuolization of the nuclei, and (4) the close resemblance to the various stages of development of notochordal tissue.

From the standpoint of histogenesis chordomas are considered to be derived from either (a) persistence of notochordal tissue in an abnormal situation, or (b) traumatic release of notochordal tissue from a region where it is normally found.[14] Thus chordomas may be found in the region of the clivus, occipital bone, hypophyseal region, nasopharyngeal region,

alveolar region, cervical, thoracic, or lumbar vertebral column, and in the sacrococcygeal region, where they are most numerous.

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A musculospiral paralysis complicating a fracture of the humerus can sometimes be left to recover with operation, provided the fracture is properly reduced and relief to the nerve is afforded in the treatment.

ACUTE PERFORATION OF A DIVERTICULUM OF THE SIGMOID

TREATMENT BY OPERATION AND SULFANILAMIDE

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SUDDEN perforation of an acutely inflamed diverticulum of the sigmoid is an unusual accident. Still more unusual is recovery from such an accident. Isolated reports of sudden perforation of an acutely inflamed diverticulum of the sigmoid usually followed by general peritonitis and death within a few hours, whether or not the patient is operated upon, have been reported in the literature. Rankin and Brown say: "Acute perforation of a mobile segment of a colon is unusual. We have seen it in an occasional case in the Clinic (Mayo) . . . our experience is small in this type of case and the mortality rate is high."

The sudden emptying of feces from the sigmoid into the clean peritoneal cavity, which immediately causes a violent peritonitis, has been in most cases too great a shock for the patient to withstand and death has been the outcome.

The following report of a case of sudden perforation of an acutely inflamed diverticulum followed by complete recovery emphasizes a few salient points worthy of consideration:

CASE REPORT

I first saw Mr. R. G. (Case No. 99325) at the New Rochelle Hospital in consultation with Dr. William Le Furgy on the evening of February 5, 1941. Dr. Le Furgy had sent him to the hospital about a week previously because he was having a severe attack of grippe.

During this week in the hospital the patient had had a low grade fever and an increased pulse rate. There had been a cough and some discomfort in the chest. However, toward the end of the week the patient's condition improved and convalescence seemed to be comparatively satisfactory.

Mr. R. G. had never had any complaints referable to the abdomen. On the morning of February 5th, the day I first saw him, he was feeling comparatively well but, his bowels not having moved for two days, he had been given a soap-suds enema at 1:00 P.M. The nozzle of the enema tube was said by the nurse to have been inserted just within the anal sphincter and the enema bag held about three feet above the level of the anus. A few minutes after the enema had been started the patient complained of sudden and severe pain in the lower part of the abdomen. This pain was severe enough so that he cried out. The enema was stopped at once; the bowels did not move. The patient immediately became nauseated and vomited several times. He did not go into shock. During the next seven hours there were severe abdominal pain, nausea and vomiting. The abdomen, which had been only moderately distended, became markedly distended. The patient probably did not pass any gas by rectum during the afternoon. When I saw the patient at 8 P.M. the temperature, which had been normal on the preceding day, was 102.8°F. by rectum and the pulse 120 per minute.

Examination, seven hours after the enema, showed an elderly white man in bed complaining of nausea and of severe pain in the lower part of the abdomen. He was acutely ill. He gave the impression of being at least five years older than his stated age of sixty-six years.

He was conscious but not entirely rational. The skin was soft, smooth and dry. The tongue was dry and markedly coated. The heart action was rapid. The abdomen was markedly distended. There was moderate tenderness in the left lower quadrant of the abdomen with marked tenderness and marked rigidity in the right lower quadrant. There was also some tenderness in the right upper

quadrant of the abdomen. Percussion of the right chest anteriorly showed a sharp change from the normal pulmonary note to a tympanic note over the liver. No dullness over the liver could be made out. Rectal examination showed no mass and no tenderness.

The white blood count which had been normal a few days previously was now 23,000 with 93.5 per cent polymorphonuclear cells and 36 per cent young forms.

Sagittal *x*-ray films were taken with the patient lying on the left side. They showed a definite collection of air between the liver and the lateral abdominal wall.

I made a clinical diagnosis of rupture of the large intestine, exact site not determined. I advised immediate operation in spite of the fact that the patient's general condition was so bad that I considered it practically desperate.

One thousand cc. of 5 per cent glucose in normal saline solution were given by vein. The patient was taken to the operating room about 11:00 P.M., ten hours after the enema. A spinal anesthetic of pantocaine 15 mg. was given. During the operation an additional 1,000 cc. of 5 per cent glucose in normal saline were given by vein.

For the reason that the maximum tenderness was in the right lower quadrant of the abdomen I made the incision through the right rectus muscle below the level of the umbilicus. On opening the peritoneum a large quantity of fluid containing small pieces of fecal matter floated into the wound. The peritoneal cavity was seen to be distended by this fecal matter from the lower large intestine. All of the peritoneum which I saw was markedly inflamed.

I sucked out about 1,000 cc. of colon bacillus—smelling fluid from the peritoneal cavity. Gentle examination of the large intestine showed an indurated segment of the sigmoid just to the left of the midline. This indurated segment of the sigmoid was brought into the wound. A perforation about 1.0 cm. in diameter was found on the antimesentric border through what was apparently a diverticulum. Surrounding the perforation there was an area of induration about 5.0 cm. in diameter. It being impossible to close the perforation because of the induration of the intestinal wall, I exteriorized it.

I put two handfuls of sulfanilamide powder into the peritoneal cavity and into the subcutaneous wound. I then closed the wound around the sigmoidostomy and made no attempt to drain the peritoneal cavity.

A Levin tube was inserted immediately after operation and the stomach was drained intermittently for six days. Thereafter the tube was discontinued.

The spinal anesthetic had been entirely satisfactory. The patient was returned to bed in poor condition; so poor that the family were told the outlook for his recovery could not be optimistic. It hardly seemed possible that a man of his age and general physical condition could withstand so overwhelming an infection. However, during the first twenty-four hours after operation his general condition improved markedly. He became rational. He was interested in his surroundings. On the day following operation the temperature reached a maximum of 100.8°F. by rectum and the pulse a maximum of 105 per minute. The rectal temperature reached normal on the fourth day after operation and remained normal throughout the remainder of his stay in the hospital except for three days when it went as high as 102°F. During these three days examination showed a few râles at the base of the lungs which may account for the rise of temperature.

For the first week after operation the patient was given daily from 2,000 to 4,000 cc. of 5 per cent glucose in normal saline or in distilled water. In this way the quantity of urine secreted was kept between 1,000 and 1,900 cc. a day. The patient was also given 5 cc. of neoprontosil intramuscularly every four hours for four days after operation.

The concentration of sulfanilamide in the blood stream during this time was found to be between 6.5 mg. and 7.5 mg. per 100 cc. of blood. A culture of the fluid removed from the abdomen showed colon bacilli.

The improvement in the general condition of the patient was surprisingly satisfactory. Locally the wound healed kindly. There was at no time distention, rigidity or great tenderness of the abdomen. The patient passed gas by rectum a few days after operation. On the day following operation he took fluids by mouth. A week after operation he was having a soft diet without untoward results. Twelve days after operation he was allowed to sit in a chair. Two weeks after operation he was given a transfusion of 475 cc. of citrated blood because of a

mild anemia. At this time he was having a liberal diet.

He was kept in the hospital for six weeks after operation. At the time of discharge from the hospital the abdominal wound was well healed around the sigmoidostomy. The opening into the intestine was only 1.0 cm. in diameter; there was almost no discharge from it, and the patient was having normal bowel movements. He was walking about in his room and was enjoying comparatively good health.

Since his discharge from the hospital the patient has steadily improved in health. He was able to return to his work as a guard in a bank about three months after operation. Now, fifteen months after operation, he feels strong and well. The opening into the intestine, however, is still present and shows little indication of healing. There is a hernia of moderate size around the abdominal scar.

Except for the fact that the patient is obliged to wear a pad over the sigmoidostomy he has no complaints referable to the accident or to the operation.

CONCLUSIONS

This case illustrates a few points which are important: (1) Even an acute perforation of the sigmoid in an elderly patient does not necessarily mean death. (2) The value of the *x*-ray in showing gas between the liver and the lateral abdominal wall when films are taken with the patient lying on the left side. (3) The value of a spinal anesthetic in the management of generalized peritonitis. (4) The great value of sulfanilamide placed within the peritoneal cavity in the presence of a general soiling with sigmoid fecal material. (5) The excellent result which was obtained in this case without drainage; drainage would undoubtedly have been a liability rather than an asset. (6) The value of exteriorizing the sigmoid at the site of rupture rather than attempting to close the perforation. (7) The smooth postoperative course which this patient has enjoyed.

SURGICAL TREATMENT OF MEDICAL JAUNDICE

CASE REPORT

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IN a previous communication[1] one of us described a method of, and the early results of, postoperative perfusion of the biliary ductal system (intra- and extrahepatic) using fluids heated by thermostatic control. The follow-up of this work has produced many interesting findings, one of which is this: The volume of bile flowing from a T-tube may be increased as much as five times, following intrahepatic lavage with heated fluids, 125 to 140°F., as registered by a thermometer at the T tube entrance. (Fig. 2.) The clinical significance of this finding lies in the fact that the application of controlled heat, *to the individual liver cells*, may greatly increase the efficiency of the liver as a working unit. This fact has a wider clinical application in that, if this hypothesis is proved correct, the present therapy of some forms of liver disease, particularly the cases of so-called medical jaundice, may become radically changed. This paper concerns the report of a case which indicates that this hypothesis has much foundation in fact. The case history will follow a brief resume of the original paper which is given so that the reader may better understand the case presentation and discussion.

Résumé. Rearrangement of biliary anatomy does not, and cannot, remove *all* the pathological condition, either causative or resultant, of biliary tract disease, even though the symptoms may be completely relieved. Something other than cholecystectomy must, therefore, be necessary. This "something else" is often the presence of a normal ductal system, *both in and out of the liver.* One of the principles of biliary surgery should be the production of such a normal system in as far as this is possible; that is, to promote normal physiological functions throughout the biliary system, which extends *from the smallest bile radical to the duodenal mucosa.* The successful accomplishment of this will prevent, in a maximum degree, the occurrence of further symptoms. On this premise it was thought (1) that the more thorough cleansing of the ductal system which would result from perfusion, and (2) the application of heat to the interior of, and to the actual disorder in the biliary system would improve the overall end results of surgical treatment. This thought was also based on the recognized fact that the present methods of treatment (T tube or catheter drain) do not always produce normal conditions in the ducts. That the present methods of operative and postoperative treatment in general are not always successful is evidenced by the work of many and is a fact recognized by all. Among the partially or wholly correctable causes of postoperative symptoms are calculi remaining in the ducts, pancreatitis, cholangitis, hepatitis, and a nervous imbalance of the choledochoduodenal apparatus. It was suggested that the incidence of these conditions might be lowered following controlled perfusion and internal lavage with heated fluids, and that the end results would, therefore, be improved.

The theoretical and practical value of this procedure was discussed under the following headings: (1) *Uphill versus downhill drainage* i.e., T tube drainage versus perfusion. The quantity of drainage bile was found to be larger and drainage was

better along the normal natural anatomical downhill passage (common duct) than it was through a T tube which drains uphill, and only then when the intraductal pressure is greater than the perpendicular height of the tube. Also in uphill drainage only the lighter material floats to the top; the heavy débris stays at the bottom in the duct. (2) *Small duct involvement* (intrahepatic): When the resistance of the sphincter of Oddi was increased by morphine, and the patient placed in the Trendelenburg position, slow perfusion allowed the fluid to penetrate into the small intrahepatic radicals. It is too seldom appreciated that these smaller but important branches of the larger biliary tree are often involved in biliary disease, particularly in obstructive cases (repeated jaundice), and that on many occasions an insufficient effort is made to correct this condition. Heat and intrahepatic cleansing fluids (lavage) were shown to be an improvement. (3) It was found that the common duct was more thoroughly cleansed by perfusion under controlled pressure than by a T tube or catheter drain which is, in reality, only an overflow. (4) *Pancreatitis:* The importance of long and continued drainage of the common duct is a recognized method of treating pancreatitis associated with biliary disease. It was argued that the use of heat by this method theoretically improves the blood and lymph circulation of the biliary system, including the pancreas, and that it might improve the treatment of residual pancreatic pathological states. (5) *Dilation of the sphincter:* It was suggested that slow, continuous and controlled dilation of the sphincter should have many advantages over acute surgical dilatation. It produces less trauma and is theoretically more permanent. That the sphincter can be dilated was shown by the fact that, after three months perfusion, the perfusion time was greatly reduced even though larger amounts of fluid were used at a much lower pressure. (6) *Postoperative colic:* The incidence of such colic was shown to be theoretically greatly lessened. (7) *Ductal washings:* That cleansing is much more thorough by perfusion than by the T tube overflow was seen when the perfusion fluid was collected through a duodenal tube and compared to T tube drainage.

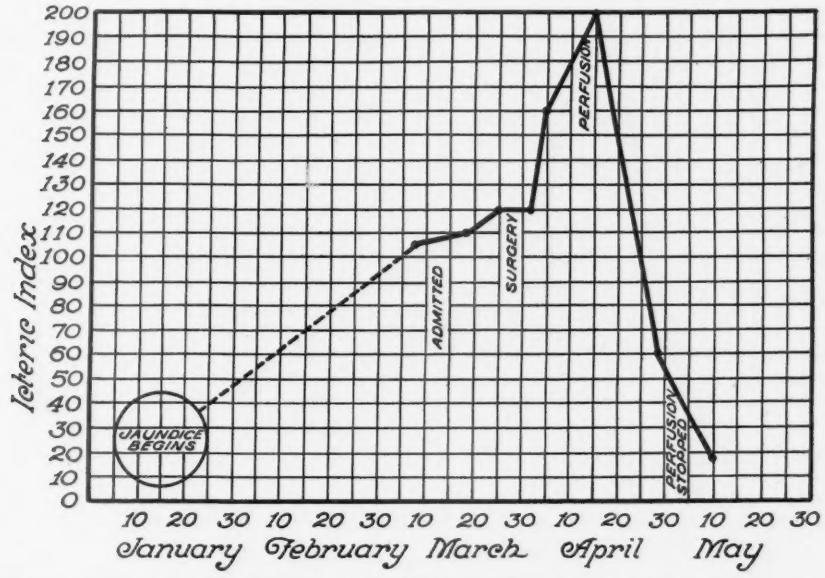

FIG. 1. Shows graphically the gradually increasing icteric index and the rate at which it receded following treatment by perfusion.

Conclusions. It was proved that the ductal system could be cleansed by perfusion more thoroughly than by T tube drainage; that small stones might be washed or "flushed" out of the common duct; that controlled heat could be applied

simply and easily for prolonged periods to the interior of both the intra- and extrahepatic biliary system and that the end results of surgical treatment should

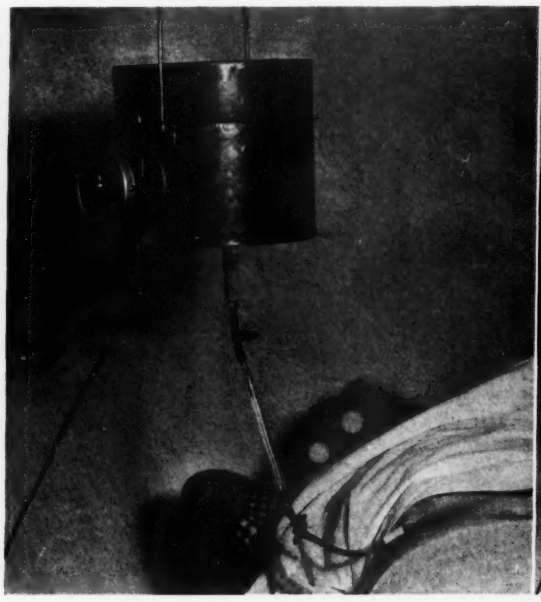

Fig. 2. The apparatus as shown is attached to a T tube. An intravenous thermometer records the temperature of the fluid at the point of abdominal entrance. The recording end is placed at the T tube entrance so that the heat loss between the mercury bulb and the point of distribution is minimum. The Baxter intravenous jar is encased in a water chamber which is heated by the thermostatic control on the outside, and the vacuum drip emerges through an opening at the bottom.

Fig. 3. The insulated cover has been removed and the apparatus turned on the side to show the interior. The intravenous jar fits snugly into the the central hollow which is surrounded by water. It is arranged in this way so that the jar may be removed and replaced with ease. Stop-screws control the rate of flow. An opening, which is on the far side and cannot be seen, allows the fluid level to be viewed at all times.

thereby be improved in a certain number of cases, particularly those complicated by inflammatory and/or obstructive lesions as small calculi, pancreatitis, sphincter imbalance, cholangitis and choledochitis.

CASE HISTORY

The following case is reported briefly as an example of the possible clinical application of biliary perfusion in the treatment of intrahepatic (medical) jaundice:

Mrs. L., age seventy-four, entered the hospital in Rochester, New York, March 14, 1941. Her only complaint was "jaundice" which had been present and progressive for approximately seven weeks. She first consulted a physician on March 3, eleven days before admission. Her icteric index at that time was 105. Four days after admission (March 18) the index was 110. A provisional diagnosis of extrahepatic obstructive disease, probably carcinoma of the head of the pancreas, was made. Surgery was performed by Dr. Houck on March 27. Thorough exploration revealed no obstructive lesion and a section of the liver was removed for biopsy. A T tube was placed in the common duct. The pathological report of the liver section revealed a thickened capsule; numbers of small bile ducts were isolated from liver tissue; in the portal areas masses of infiltrating round cells were seen, giving the appearance of lymph follicles. There was no evidence of malignancy. The pathological diagnosis was "chronic hepatitis."

Eight days after operation the icteric index had risen to 160; twelve days after operation it had reached 200. (Fig. 1.) Shortly after this the patient began to show early signs of advancing cholemia; the temperature became unsteady and the pulse lost quality; lethargy increased; mental instability appeared, and the bile drainage from the T tube was "thinner than water," very small in amount and showed practically no color. A bad prognosis was given by both the medical and surgical consultants.

On April 16, twenty days after operation, perfusion was started. (Fig. 2.) During this twenty day postoperative period the icteric index had risen from 120 to 200. There was no extrahepatic obstruction as determined by cholangiographic study and a postoperative diagnosis of intrahepatic jaundice had been made. Five hundred cc. of 5 per cent glucose in normal saline was given once a day. The temperature of the perfusing fluid varied between 115 to 130°F. On April 29, (thirteen days after starting perfusion) the icteric index had dropped to 60. Ascites, probably due to the excessive administration of sodium chloride, developed on May 1. On May 3, seventeen days after the start of perfusion, it was discontinued. The T tube was removed on May 5. On May 10, her icteric index was 18. (Fig. 1.) On May 1, 1942, she had had no recurrence of the jaundice and was enjoying apparent perfect health.

DISCUSSION

A case of proved intrahepatic (medical) jaundice which had been gradually increasing in severity for eleven weeks began to subside immediately following the institution of biliary perfusion and it soon disappeared. (Fig. 1.) The logical question is: Was this prompt remission of the jaundice a coincidence or was it the result of perfusion? The writers believe that it was not a coincidence and that the result here reported was the direct consequence of a definite treatment. The condition of the patient had been growing steadily worse over a period of eleven weeks before perfusion was started. It is most unlikely that spontaneous improvement should have begun at this moment when all other methods of therapy had previously failed. Marked clinical improvement was clearly seen in thirteen days. (Icteric index fell from 200 to 60, from April 16 to April 29.) If this improvement was not the result of perfusion, what other factors could be involved? It is clear that the circumstantial evidence is overwhelmingly in favor of perfusion.

This report must not pass as just another "interesting case." It opens a field of therapy that is far reaching in its possibilities. For example, what might it not do for the other forms of liver disease such as multiple abscesses, postoperative hepatic insufficiency, suppurative cholangitis or other cases of intrahepatic jaundice.

The chief argument against the use of perfusion is that it is a surgical procedure which must be used on a sick patient. We now "watchfully wait" beside the patient with medical jaundice (and other intrahepatic conditions) because there is nothing else to do. The treatment is many times only supportive, which in itself is supported by hope and prayer. Neither of these measures attack the etiology. Perfusion of the intrahepatic ductal system does.

From a clinical standpoint, in the very few cases studied, it seems that the application of controlled heat (120 to 140°F.) to the liver cell and to the actual seat of the disorder, by means of ductal perfusion, does relatively and absolutely increase the efficiency of the liver as a working unit, as determined by the greatly increased flow of bile.

Because it is uncommon to have a T tube in the common duct of a patient with medical jaundice, and because biliary perfusion suggests a new and hopeful approach to a large field, and because the war prevents planned experimental work being carried out, a single case history is considered worthy of presentation. This report is made with the hope that it will stimulate a thorough discussion and investigation of the subject.

CONCLUSION

Because one case is insufficient evidence on which to base any conclusion, and because much experimental and clinical work remains to be done, it is suggested, rather than concluded, that this method of treatment opens up a new and beneficial field in the therapy of liver disease. This is sufficient justification for the present presentation.

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MULTIPLE PRIMARY NEOPLASM OF THE COLON*

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IT is well known that carcinoma of the colon (with the rectum) accounts for over one-tenth of all deaths due to malignant disease.[1] Operability of neoplasms of the colon is estimated to be from 38 to 81 per cent and the mortality for radical operation averages about 20 per cent.[2] The incidence of multiple primary malignancy is variously estimated between 0.6 and 4.3 per cent.[3] Therefore, although it may no longer be a rarity, the successful radical removal of multiple primary carcinoma of the colon seems worthy of consideration and is the subject of the present report.

Salient facts are worthy of repetition. It is said that Cserny, in 1880, was the first surgeon successfully to resect multiple carcinomas of the colon.[4] In 1918, Major, in an exhaustive review of the literature, recorded 628 examples in which multiple primary malignant lesions were found.[5] Multiple neoplasms were reviewed by Warren and Gates in 1932 and they collected more than 1,200 cases of multiple primary malignancies. There were fifty-five cases of multiple carcinoma of the colon. Bacon, in 1939, collected and reviewed 155 cases of multiple primary malignant lesions involving the anus, rectum or sigmoid.[3]

Criteria have been advanced to establish the independence of multiple primary neoplasms. Billroth postulated: (1) Each neoplasm must show independent histological characteristics. (2) Each neoplasm must rise from its parent epithelium. (3) Each neoplasm must produce its own metastatic lesions.

Mercanton added that if after removal of the two neoplasms the patient remains free of disease the independence of the tumors is assured.

The prerequisites of Warren and Gates were: (1) Each neoplasm must be malignant. (2) Each neoplasm must be distinct. (3) The second neoplasm cannot be a metastatic implant from the first.

When tumor occurs in a single group of cells its origin is unicentric. When several groups of cells give rise to more than one neoplasm it is of multicentric or pluricentric origin.[3] Multiple cancers may be divided into two classes: (1) Synchronous, when they occur simultaneously, and (2) metachronous, when they occur at different times.[7]

CASE REPORT

R. K. Record No. 116091. A seventy-one year old white male was admitted October 17, 1940, with a four-day history of malaise, right lower quadrant pain and nausea. The pain was constant but there was no increase in severity. Although nausea was present the patient did not vomit. No abnormality of bowel function was noted. The patient had gained weight during the past two months. He had influenza in 1919, diabetes mellitus since 1925, Parkinsonism since 1925, and underwent prostatectomy in 1932.

Physical examination revealed an elderly, extremely nervous male, not acutely ill. His temperature was 98.4°F., pulse 96, respirations 20. The blood pressure was 190/94, heart not enlarged, rhythm regular, sounds of good quality and there were no murmurs. The chest was symmetrical and expansion equal. Lungs were resonant and breathing vesicular. There were no râles. The abdomen was symmetrical

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and a vertical midline scar (prostatectomy) was present. There was no distention. The abdomen was soft with slightly increased muscle tone over the right half and most pronounced in the right lower quadrant. Definite rebound tenderness was present in the right lower quadrant. A round, smooth, movable, slightly tender, hard mass about the size of an orange was palpated in the right lower quadrant. Normal peristaltic sounds were heard with the stethescope. On rectal examination no intrinsic pathological disturbance could be palpated and the mass palpated abdominally could not be felt through the rectum.

The provisional diagnosis was: (1) carcinoma of the ascending colon, possible cecum; (2) possible appendiceal abscess; (3) Parkinsonism; (4) diabetes mellitus; (5) essential hypertension.

The abdominal pain subsided. On October 18th, a barium enema revealed constant irregularity and narrowing of the lumen of the colon at the junction of the descending and sigmoid colon. The mass in the right lower quadrant persisted and a second barium enema was done. The defect at the junction of the descending and sigmoid colon was again visualized. A second annular constriction was noted at the junction of cecum and the ascending colon. The findings indicated two organic annular lesions, one at the junction of the descending and sigmoid colon and the second at the junction of the cecum and the descending colon.

The patient was prepared for surgery by the usual routine which included a liquid non-residue diet, colonics of 0.5 per cent sulfanilamide solution, intravenous fluids, vitamins and hematinics. Blood was banked for operation.

Fig. 1. Fig. 2.

Figs. 1 and 2. Barium enema on October 18, 1940. Findings indicate two organic annular lesions, one at the junction of the descending and sigmoid colon and the second at the junction of the cecum and ascending colon.

Celiotomy was performed on October 24th under cyclopropane inhalation anesthesia through a 15 cm. subumbilical left rectus incision. The stomach, liver and bile ducts, pancreas, spleen and kidneys were normal. There was no evidence of any metastasis. At the junction of the descending and sigmoid colon a hard constricting mass was palpated, the mass was about 8 cm. in diameter. The second mass was palpated in the ascending colon just above the ileocecal junction. It was about 12 cm. in diameter. The terminal ileum was divided 20 cm. proximal to the ileocecal valve and the ends inverted. A side-to-side anastomosis was performed between the ileum and the transverse colon. The lesion at the junction of the descending and sigmoid colon was mobilized by cutting the lateral peritoneal reflection, permitting the tumor to be exteriorized after the method of Mikulicz. The bowel was exteriorized through a small second incision in the left inguinal region. The left rectus incision was closed in layers.

The second stage was performed on October 28th at which time the exteriorized loop of colon with the tumor was excised with the cautery. Clamps were applied to the spur. The patient was having good bowel function through rectum by November 7th. The left rectus incision healed by primary union.

On November 14th, the third stage was performed under cyclopropane anesthesia through a 20 cm. right rectus incision. The previously closed stump of ileum was located. The terminal 20 cm. of ileum, cecum and appendix and the right half of the colon with the second tumor (to a point 5 cm. distal to the previously performed transverse ileocolostomy) was resected. The anastomosis was inspected and found to be well healed. There was no evidence of metastasis. The right rectus incision was closed in layers.

There were no postoperative complications and the right rectus incision healed by primary union.

There was persistence of the Mikulicz fistula and in spite of adequate breakdown of the spur there was still some abdominal drainage although the majority of bowel movements were entirely through the rectum. Plastic closure of the fistula was therefore proposed. A soft rubber rectal tube was passed through the rectum to a point 10 cm. above the fistula prior to operation. On January 13, 1941, the fistulous tract was excised and the colon closed by the usual procedure.

There was primary wound healing. Normal bowel movements occurred daily; the patient was ambulatory. After a short period of observation the patient was discharged on February 1st.

Patient was readmitted on July 22, 1941, at which time there was no clinical evidence of recurrence of the carcinoma. Reexamination of the colon by barium enema did not reveal any pathological condition. The patient was discharged on August 1st.

He was again readmitted November 1, 1941, and at this time barium enema showed a defect in the transverse colon which was suggestive of a polyp. The patient was discharged November 25th.

Following discharge from the hospital he returned to his home and apparently remained in good condition for several weeks. He then committed suicide and no autopsy was performed.

The pathological report on October 28, 1940, revealed the following:

There was a tumor mass from the descending and sigmoid colon. The specimen consisted of a section of the large bowel. On opening the bowel, there was a large cauliflower growth occupying the midportion of the bowel for a distance of 6 cm. There was a hard thickening of the wall of the bowel with narrowing of the lumen. There was ulceration of the mucosa at this point. The mucosa on either side of the tumor was markedly edematous.

Microscopic examination revealed that there were large areas of neoplastic proliferation, polypoid in type with elongated glands lined by heteroplastic cells. The stroma was fibrotic with areas of lymphocytic infiltration. Sections of the terminal portions of the bowel showed no neoplastic tissue. Diagnosis: Polypoid adenocarcinoma of the descending and sigmoid colon.

On November 15, 1940, the resected terminal ileum and right colon was examined. The specimen consisted of the terminal ileum, cecum and appendix, and adjoining right colon. On opening the bowel there were several large cauliflower-like growths in the cecum and adjoining colon measuring 1 to 5 cm. in diameter.

Microscopic description was as follows: The intestinal mucosa showed neoplastic growth of polypoid appearance, papillary in type. The papillae were lined by several layers of anaplastic cells with many atypical mitoses and many hypersecreting mucous cells. Diagnosis: Papillary adenocarcinoma of the cecum and ascending colon.

Repeated urinalysis showed the urine to vary from light yellow to amber color, clear to slightly cloudy, with a hydrogen ion concentration of 5.5 to 7.5, specific gravity 1.014 to 1.022. On several occasions there were traces of albumin and sugar. At no time was acetone or diacetic acid present. White blood cells, red blood cells, epithelial cells and hyaline casts were occasionally present.

Blood counts: On October 17, 1940, the counts were as follows: hemoglobin 73 per cent, erythrocytes 3,920,000, leucocytes 11,250, mature polymorphonuclear leucocytes 63 per cent, immature polymorphonuclear leucocytes 5 per cent, lymphocytes 28 per cent, eosinophiles 3 per cent, monocytes 1 per cent. On November 3, hemoglobin 76 per cent, erythrocytes 4,430,000, leucocytes 14,300, polymorphonuclear leucocytes 84 per cent, lymphocytes 13 per cent, eosinophiles 2 per cent, basophiles 1 per cent. On January 12, 1941, the hemoglobin was 78 per cent, erythrocytes 4,500. Repeated blood sugar estima-

tions varied from 74 mg. to 108 mg. The Wassermann test was negative.

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IN fractures of the spine it is important, as it is in extremity fractures, to restore the spine at once to correct length by suitable traction and manipulation, and to replace all the parts in correct anatomic relationship.

BRUCELLA SPONDYLITIS

CASE REPORT

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ALTHOUGH sixty-four cases of spondylitis complicating undulant fever have been reported to date, only three of the patients were treated by surgical fusion. The purpose of this communication is to add the sixty-fifth case and the fourth one in which operative fusion was employed. Mazzocchini states that it is necessary to make a most thorough study in the differential diagnosis. This case bears out the wisdom of such advice.

CASE REPORT

In December, 1939, A. W., a twenty-three-year old *farmerette* in the fourth month of pregnancy (primipara), stooped to lift a small child when she felt a painfully sharp "click" in the lower portion of her back. The pain persisted and her family physician advised that its cause was undoubtedly the excessive weight of the embryo. In May, 1940, however, a normal, full term infant was delivered without the expected relief from pain. Actually, the pain became progressively worse until at the end of three months, the patient could endure it no longer and her physician referred her to an orthopedist for extensive roentgenologic examination.

On the basis of the roentgen findings and a positive (?) Vollmer patch test, a diagnosis of tuberculous destruction of the fourth lumbar vertebra was made. (Fig. 1.)

The patient was institutionalized in a tuberculosis sanitarium where she remained recumbent for five months in a double-leg spica jacket. While there, additional roentgen study was undertaken and on one of the films, a psoas bulge was visualized. A trocar was introduced in order to aspirate the swelling, but during the procedure, the instrument broke at its hilt. To remove the imbedded portion, formidable surgical intervention was necessary.

The purulency obtained cultured sterile, as is not infrequent in a "cold (tuberculous or brucellosis) abscess"; in spite of diligent search, however, at *no time* had there been found any *evidence* of *tuberculosis*. Finally, in December, 1940, the patient was discharged home, recumbent in a bivalved double-leg spica jacket with a most actively draining sinus in the left groin.

I saw her for the first time in January, 1941, and while I was delving into her past history, the patient recalled (*for the first time*) that in January, 1939, about one year prior to onset of back symptoms, she had experienced a high, *unexplainable temperature* for a period of ten days, following which recovery was apparently complete.

Blood titers for undulant fever were now advised and done; the concentration from the State laboratories proving to be 1:1000 in 1,024.

The patient was then transferred from her home to a hospital in Pittsfield, Massachusetts, where the persistent sinus was treated locally (ether, Petroff's iodine solution, etc.) but without success. As her temperature continued to fluctuate, it seemed advisable to administer an intensive course of sulfanilamide. This was done with the result that the temperature subsided.

Meanwhile, however, serial roentgenograms (Figs. 2 and 3) had revealed a rapidly progressive destruction of the fourth lumbar body with suspicious involvement of the third, and early neurologic symptoms, viz. root pain, etc.

In view of these findings, I deemed it advisable that a spine fusion be attempted before the posterior elements with total collapse ensued. Consequently, on February 21, 1941, a spine fusion was undertaken, extending from the third to the fifth lumbar body inclusive, adhering to the Hibbs' technic, overlaid by an osteoperiosteal graft from the tibia. At the time of surgery, if the posterior element involvement had been suspected, fusion would

FIG. 1. Area of destruction is faint though readily discernible.

FIG. 2. Destruction area is now larger and more circumscribed. The joint space between the fourth and fifth lumbar, has become narrower with a corresponding widening of the joint space between the third and fourth lumbar.

FIG. 3. Destruction is progressive, the area is beginning to crumple and encroach posteriorly.

FIG. 4. Fusion area is solid and previously necrotic area is healed.

have been extended to the sacrum. The incisional wounds healed per primum and the patient's postoperative course was uneventful.

Eight weeks later, after the patient had been removed from her recumbent plaster of paris shells and a snug-fitting body jacket had been applied, she was discharged home comfortably ambulant. Her convalescence continued uneventfully for six months after leaving the hospital, the groin sinus healing in the interim.

Then, suddenly, the patient's temperature rose to 105.2°F. with pain in the groin *opposite* the now healed sinus. Examination revealed a fluctuant mass, the size of an orange.

This was incised and drained, with the evacuation of about 100 cc. of thick, greenish-tinged purulence, after which the patient's temperature dropped to normal and she became symptom free. This purulency, like the first, cultured sterile. For a while both sinuses would drain at intervals until eventually, they would close over and remain closed for several days, with an accompanying rise of temperature and abdominal distress. As long as either sinus drained, she was entirely comfortable and symptom free. Repeated blood titers indicated that a positive agglutination persisted. The roentgenograms revealed definite healing of the fourth lumbar body with no right or left psoas bulge.

Communication was now made with the laboratories of the Michigan State College, Central Brucella Station, and, following a course of brucellin therapy, which was administered for four months in accordance with suggested directions, the sinuses stopped draining and promptly healed, after which the patient experienced no further abdominal distress.

Six months after the discontinuance of brucellin, the blood titer continues to be negative, the patient remaining symptom-free and perfectly comfortable. A recent roentgenogram (Fig. 4) of the spine revealed a solid fusion area with a healed fourth lumbar vertebra.

CONCLUSIONS

1. A case of spondylitis complicating undulant fever wherein surgical fusion was successfully employed is presented.

2. Brucellin proved to be a most valuable adjunct.

3. Had not the differential diagnosis been established when it was, fusion might have been performed too late for the patient's benefit.

4. Therefore, the early differential diagnosis in cases presenting a similar clinical picture is urged.

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Two common causes of disability following injuries to the foot are: failure to recognize fractures with minor deformities, and failure to protect the foot by special shoes and braces against further damage by weight-bearing afterward.

CAVERNOUS HEMANGIOMA OF THE SKULL*

CASE REPORT

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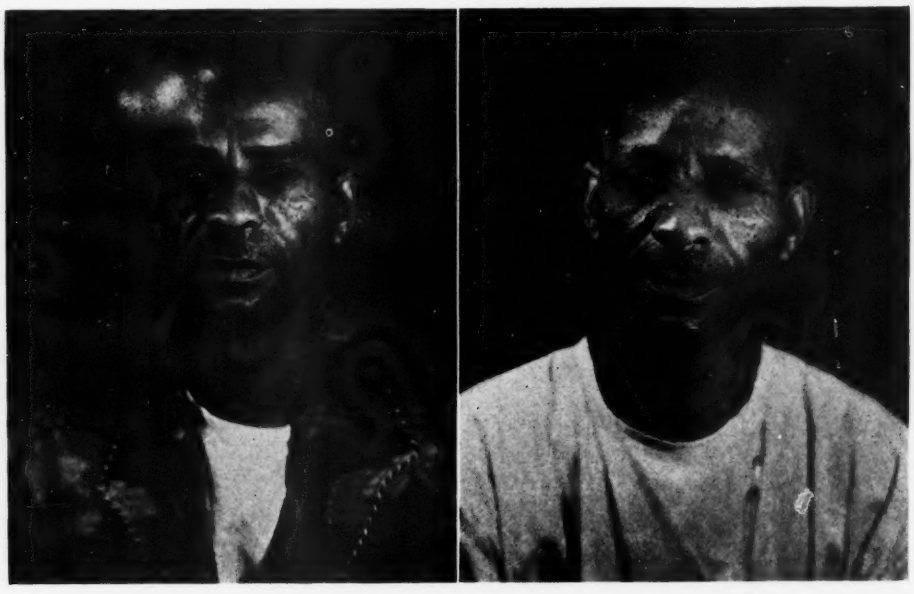
HEMANGIOMAS are tumors composed of newly formed blood vessels. Such growths may be cavernous or capillary in type and, when they occur in bone, are more often found in the cranium and spine than in other parts of the skeleton. They are usually benign and may or may not cause symptoms. In the case of cranial hemangiomas their growth is gradual and as they increase in size, headaches, vomiting and even convulsions may be experienced. A definite diagnosis can be made from the characteristic "sunray" appearance seen in the roentgen ray films. Operative removal of the tumor, when possible, offers the best results.



A B

FIG. 1. A and B, preoperative and postoperative photographs of the patient.

The disease is rare. Since Toynbee[1] first described an angioma of the skull in 1845, sporadic references to the condition have appeared in the literature. In 1930, Bucy and Capp,[2] in a review of the literature, found eighteen cases of angioma of the skull in fifty-six cases of hemangioma of bone. Seven years later, Anspach[3] was able to collect twenty-one cases of hemangioma involving the skull and reported a case of his own. The most recent review of the literature by Abbott,[4] in 1941, reveals only twenty-six reported cases of angioma of the skull. He presents an additional case and since his review, one more case has been recorded.[5] These, together with the one we are presenting, bring the total number of reported cases to twenty-nine.

The following case of cavernous hemangioma of the right frontal bone, including

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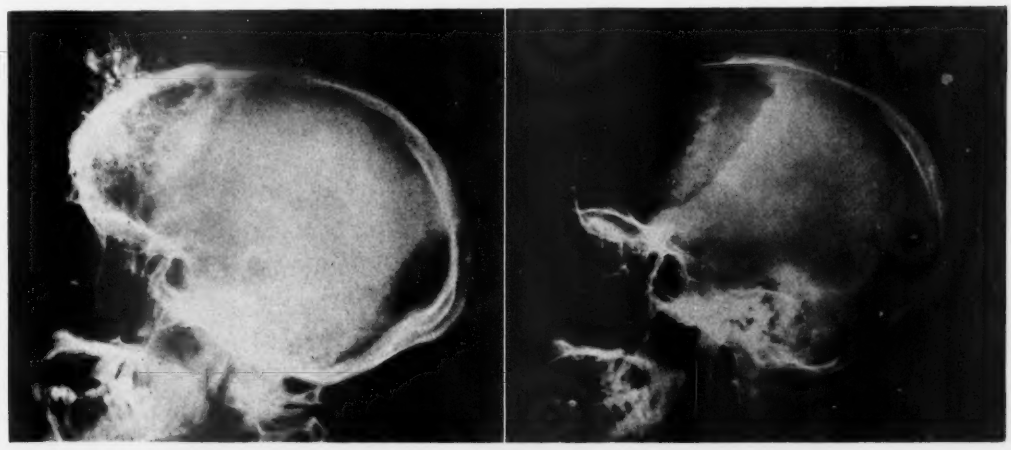
the superciliary arch and orbital plate, is reported not only because of the rarity of the condition but also because it has been stated[3] that operation on hemangioma this size would be fatal.



A B

Fig. 2. A and B, preoperative roentgenogram showing the "sunray" appearance of the tumor and postoperative roentgenogram showing the defect after removal.

CASE REPORT

E. H., a colored farmer, aged forty-seven, entered Charity Hospital in New Orleans, March 3, 1941, because of a large tumor of the forehead causing intermittent aching pain. About twelve years before admission he noted a smooth, round, hard growth about the size of a pea on the right side of his forehead. For seven years the mass gradually and uniformly increased in size until it became as large as a pecan. For the next four years it grew rapidly. Since then there has been little change. The tumor was not uniformly hard but had soft areas on its surface. No subjective symptoms were experienced until three years before admission when the patient complained of intermittent aching pain in the tumor, particularly at night.

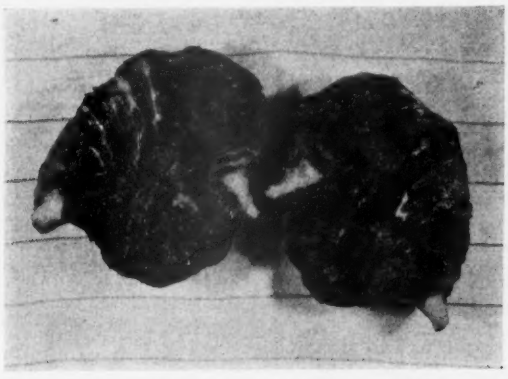


Fig. 3. Bisected specimen. The large white areas are pieces of skull. The intracranial portion of the tumor is much smaller than the extracranial portion.

Situated over the right side of the forehead, the mass projected like a horn. (Fig. 1A.) It was smooth on its surface, dome-shaped and extended from the eyebrow to a point 6 cm. behind the hair line, being entirely to the right of the midline. The skin encasing the mass was freely movable. No pulsation was noted. The mass was 27 cm. in circumference at the base and 21 cm. near the apex. The mass was firm and bony at the base and soft at the apex with areas of firmness interspersed. In the right temporal region were two dilated veins, but no bruit was heard over the tumor.

Roentgenograms (Fig. 2A) showed a tumor with perpendicular striations arising from the right frontal bone. There was involvement of the superciliary arch and the roof of the orbit. A diagnosis of hemangioma of the skull was made.

On March 12, 1941, under a local anesthetic a saggital incision was made over the tumor beginning just above the supra-orbital margin. The two flaps of skin were dissected free from the tumor. The periosteum and temporal muscle were incised around the base of the tumor with the electrosurgical knife. A single trephine was made in the skull. With this as a starting point a groove 1 cm. in width was made with a rongeur around the base of the tumor. It was necessary to remove parts of the superciliary ridge and roof of the orbit. Bleeding from bone was controlled by application

of wax. The tumor (Fig. 3) was separated from the underlying dura with the finger and lifted off in one piece. The dura was not torn during this procedure. The frontal sinus, which had been widely opened, was closed by suturing the periosteum to the dura. The tumor mass had extended inward as well as outward and had greatly depressed the dura and the underlying frontal lobe. While preparation was being made for closure of the skin, it was noted that the redundant dura had completely expanded, indicating an acute subdural hematoma. The dura was opened and the large fresh clot was removed. The surface of the brain appeared normal except that it was flattened and depressed. The bleeding vessel which had produced the subdural hematoma was grasped with a forceps and electrically coagulated. The incision in the dura was sutured to the periosteum at various points and the skin closed in layers. A drain was left in the wound for twenty-four hours because of the impossibility of obtaining complete hemostasis. The blood loss was considerable but did not fulfill expectations and replacement measures were entirely adequate. There was no shock during or after operation. A postoperative roentgenogram showed the defect in the bone. (Fig. 2B.) Convalescence was uneventful. (Fig. 1B.)

Pathologic examination of the mass revealed a firm, encapsulated tumor measuring 12 cm. by 10 cm. by 8.5 cm. and weighing 360 Gm. It consisted chiefly of hemorrhagic tissue. The microscopic diagnosis was cavernous hemangioma of the skull. (Fig. 4.)

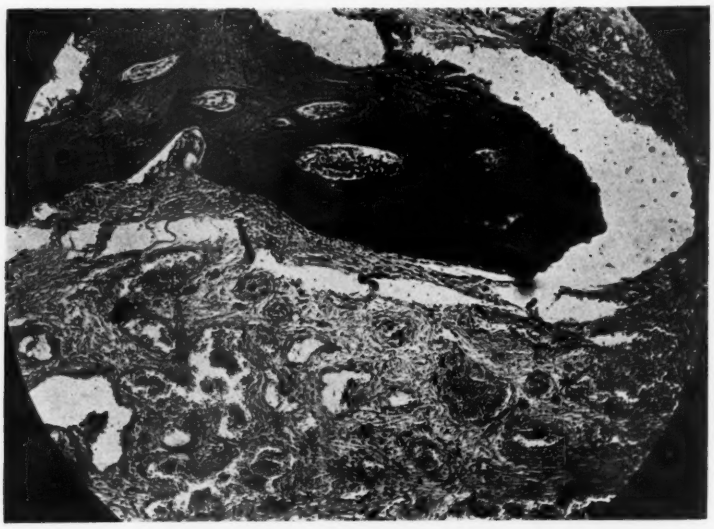


Fig. 4. Microphotograph showing typical cavernous hemangioma. The darker area is a spicule of bone.

Fifteen months after operation, on June 19, 1942, the patient was requested to return for re-examination. There was no evidence of recurrence of the tumor at this time. There were no complaints. On close questioning, however, he stated that he no longer worked on his farm at noon on hot days because giddiness resulted.

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EXCISION OF THE DUODENUM AND HEAD OF THE PANCREAS FOR CARCINOMA OF THE AMPULLA

METHOD OF ANASTOMOSING PANCREATIC DUCT TO THE JEJUNUM

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RADICAL surgery for carcinoma of the ampulla or head of the pancreas has now taken its place in their management. In a recent communication from Whipple he states that the case that I am reporting brings the total number of cases that have appeared in the literature, or have been reported to him, to about sixty-five, who have had radical surgery for carcinoma of the ampulla or head of the pancreas.

This patient presented an unusual problem in that upon his admission, he had evidence of an acute cholecystitis with a perforation of the gallbladder. At operation it was found that he had a gangrenous gallbladder, which had ruptured and bile ran free in the peritoneal cavity. There was a small liver abscess about two inches from the gallbladder. Everything was so indurated that nothing further than a cholecystostomy and a drainage of the liver abscess was carried out. There were no stones in the gallbladder. After a rather stormy course, his general condition improved. He was in the hospital about three weeks, during which time all of the bile drained out his cholecystostomy wound. No bile, whatever, went through to his duodenum. There was a lot of infection in his abdominal wall, which slowly subsided and after two months he was in such condition that it was decided that exploration of his biliary tract could be carried out. He was explored with a provisional diagnosis of a common duct stone obstructing the ampulla of Vater.

At operation the common duct was markedly dilated. It was opened and upon passing a scoop down to the ampulla, a soft mass could be felt, which was about the size of the end of the little finger. It felt like a soft stone, but nothing could be milked back. Because of this, the duodenum was then opened over the ampulla and a tumor mass could be seen. A section of this was taken and reported to be a Grade 2 adenocarcinoma. The tumor was destroyed by cautery and the duodenum closed. The common duct was then anastomosed to the stomach above the pylorus and the gallbladder removed, because it was so badly diseased that it could not be used in anastomosis. An anterior gastroenterostomy with an enteroanastomosis was made, the anterior operation being necessary because of adhesions and induration in the transverse mesocolon. The abdomen was drained. The patient, this time, made a very rapid and had a very easy convalescence. He was in the hospital about twelve days.

He, again, had a good deal of infection in his abdominal wall, so that the operation of radical excision had to be postponed again for six weeks. At the end of this time he was reexplored and the duodenum with the entire head of the pancreas was removed in one block. The pyloric end of the stomach was closed, as was the cut end of the duodenum near the ligament of Treitz. The pancreatic duct was ligated and the head of the pancreas was sutured with linen. A catheter was left into the raw bed and the space was further drained by a Penrose drain. He was given a blood transfusion on the operating table. The operation was unusually difficult because of the many adhesions and because of the persistence of a good deal of induration in the tissues. He stood the operation well. On the fourth postoperative day he developed a pancreatic fistula. For the first two days he drained 360 cc. Following that it decreased rather rapidly until at the end of the ninth day there was only 50 cc. drainage. This had completely stopped by the twelfth day, at which time he was allowed to go home from the hospital.

The functioning of the gastroenterostomy and the anastomosis of the common duct to

the stomach had been perfectly normal in every respect. There has been no jaundice and there has been no gastric retention. He is eating well and feels fine at this time. He was strong enough to report to the office for dressing on the seventeenth postoperative day. There has been no interference from the loss of the pancreatic secretion. The bowels are normal and they have not been fatty. It has been the experience of Whipple that these patients are able to digest 80 to 85 per cent of a measured fat intake. In some cases, however, pancreatic extract and lipocaic have to be administered. This is particularly true if there are fatty bulky stools.

FIG. 1. Shows the method of handling the common duct in the case reported.

FIG. 2. Shows the proposed method of handling the pancreatic duct.

The pathological examination of the specimen revealed an ulcerating carcinoma at the ampulla, a centimeter in diameter. There was infiltration of all the layers of the duodenal wall. There was no infiltration into the pancreas and there was no lymph gland envolvement found. It was diagnosed adenocarcinoma, Grade 2. Due to the fact that this man is forty-four years of age and that he had a small lesion, it is hoped that he might be able to survive for a long time so that the effect can be studied throughout the course of several years.

Prior to Whipple's advocation of radical surgery for lesions in this area, only palliative procedures had been carried out. I was unable to carry out the procedure as advocated by Whipple due to the condition of the gallbladder and I realize that the operation of anastomosing the gallbladder

to the jejunum is a more scientific procedure. Due to the serious biliary fistulas that often develop after ligation of the common duct, Whipple now anastomoses the common duct to the jejunum. This is even a better procedure.

PROPOSED METHOD OF HANDLING PANCREATIC DUCT

Up to the present time the pancreatic duct has been ligated and dropped back. Whipple has anastomosed it to the posterior wall of the stomach. In the future I believe that it will be worth considering, and I plan to utilize this method of using a rather long loop of jejunum to anastomose to the common duct as a first stage. In this way the loop, after extirpation of the duodenum and head of the pancreas, can be swung over against the neck of the pancreas and the neck of the pancreas literally inserted into the side of the jejunum. In this way the loss of pancreatic digestion will not be complete, and in order to afford better healing of the pancreas to the side of the jejunum, I propose to insert a duodenal tube through the jejunum below the site of anastomosis, stitch the tube into the pancreatic duct and after returning the patient to the room, start suction, using the Wangensteen apparatus. This should keep the pancreatic and biliary secretions away from the area of anastomosis and allow healing to take place. In about a week or ten days this catgut suture should slough out and the tube then can be removed.

Carcinomas of the ampulla of Vater should be more favorable than carcinomas of the head of the pancreas for radical surgery for they metastasize more slowly. These lesions are often very small and unless at exploration the duodenum is opened and a biopsy taken, many operable lesions will probably be overlooked. I am sure that in my case I would have entirely missed the diagnosis, had I not opened the duodenum and taken a specimen for microscopic study. I urge that this be done in all doubtful cases.

PEDUNCULATED OVARIAN CYSTS IN CHILDREN

AN AID TO DIAGNOSIS

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AFTER reviewing the literature Benjamin found that only 120 cases, including his own, of ovarian cyst

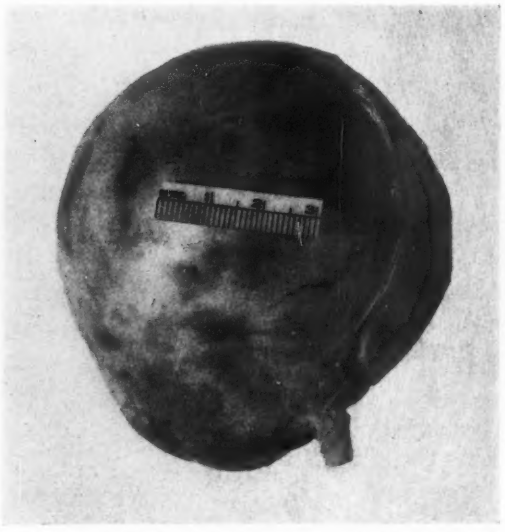

FIG. 1. Dermoid cyst showing pedicle removed from girl age nine years.

with torsion of pedicle in children had been reported up to 1940, and that the majority of these were erroneously diagnosed preoperatively as appendicitis with abscess formation. He further states that the majority of the cases of torsion occurred on the right side which might account for the error in diagnosis.

We have found that a reverse bimanual abdominorectal examination has been extremely helpful in the problem case. This is performed as follows: With the index finger of one hand palpating the cervix through the rectum, the other hand pushes the movable ovarian cyst upward toward the diaphragm as far as it will go to produce tension on the pedicle. At this point, tug-like pushes against the cyst will be transmitted along the pedicle to the broad ligament and the uterus and can be plainly felt by the finger palpating the cervix. This shows that the mass in question is attached to the uterus or adnexa and thus differentiates it from other conditions with which it might be confused and which rarely have such a pelvic attachment.

The following case illustrates the value of this maneuver:

A nine year old female was admitted to the surgical ward of the Delaware County Hospital in Drexel Hill, Pennsylvania, on November 13, 1938, with a diagnosis of appendiceal abscess. For several years she had complained of brief pains in the lower part of her abdomen, not associated with any other symptoms. There had also been some frequency of urination. About seven hours before admission the patient developed lower abdominal pains, chiefly on the right side. The pain continued intermittently. Nausea and vomiting followed the pain. The patient had had scarlet fever at four years, whooping cough at six, tonsillectomy and adenoidectomy at six and measles and mumps at eight. Her father and mother were living and well. On admission the patient's temperature was 99.3°F., pulse 100 and respirations were 22. Leukocyte count showed 12,100 white cells, 64 per cent polymorphonuclears, 35 per cent lymphocytes, 18 per cent stabs and 46 per cent segmented. Urine was negative except for a trace of albumin and a plus one acetone. Complete physical examination was negative except for the abdomen. Abdominal examination revealed slightly spastic muscles in the lower right quadrant; there was no distention or free fluid and peristalsis was apparently normal. In the lower right quadrant could be palpated a tense, tender, globular mass, smooth and regular in outline, about four inches in diameter which could be freely moved, without additional discomfort to the patient, downward into the pelvis and upward

in the midline to the level of the umbilicus. Using the reverse abdominorectal examination described above, a definite diagnosis of ovarian cyst with torsion of the pedicle was made. At operation this was verified when a cyst of the right ovary with one and one-half turns of the pedicle was found and removed. The pathologist reported a dermoid cyst of the ovary. The patient made an uneventful recovery and was discharged as well on November 26, 1938. Since then there has been no recurrence of symptoms.

CONCLUSION

1. Partly because of its rarity, ovarian cyst with torsion of the pedicle in children is difficult to diagnose.

2. A method of reverse abdominorectal examination is described which has proved helpful in diagnosing this condition.

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BENJAMIN, D. Torsion of ovarion cysts in children: report of case with recovery. *Am. J. Surg.*, 53: 500, 1941.

WHETHER the fracture of the calcaneum is simple or compound we should always secure and maintain correct length and position by a traction pin through the back of the calcaneum and a pin through the tibia above, both firmly immobilized in the plaster-of-paris cast until the fracture has healed.

RUPTURE OF THE NORMAL CECUM RESULTING FROM MALIGNANT OBSTRUCTION OF THE SPLENIC COLON*

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RUPTURE of the distended but otherwise normal cecum is mentioned in textbooks as a possible complication of large bowel obstruction, yet reports of such cases are surprisingly rare in the surgical literature. In American journals the last report of specific occurrences of this type was in 1935 by Saeltzer and Rhodes.[1] These authors cited only two other case reports by American observers in two previous decades, respectively: Hartwell in 1917[2] and Dickenson in 1922.[3]

While any part of the large bowel may perforate at the site of an ulcerative lesion such as carcinoma, tuberculosis, regional colitis, typhoid fever, etc., rupture of the normal colon as a result of overdistention apparently occurs only in the cecum. There are several reasons why the latter rather than any other portion of the large gut tends to give way:

1. In those patients in whom the ileocecal value is competent, the colon is converted by an obstructing lesion into a closed system in which the internal pressure is equal throughout. Although the pressure is the same in all parts of this system in accordance with physical laws, the force or tension against the wall varies in proportion to the square of the radius. The cecum having a larger diameter than any other part of the large intestine, is exposed to a greater bursting force. The tension against the cecal wall would be four times as great as in some other part of the colon whose lumen were half as large.

2. The wall of the cecum is normally thinner than that of any other part of the large bowel. This difference in thickness is often accentuated by the hypertrophy of bowel wall that occurs while obstruction is still incomplete. The thickening of the colon wall is greatest just proximal to the site of the obstructing lesion, gradually decreasing with distance from the obstruction and is thus minimal in the cecum.

3. When a loop of bowel first becomes obstructed, the intraluminary pressure causes obstruction of the blood supply in the intestinal wall resulting in an ischemic state which is relieved by gradual stretching of the smooth muscle of the wall until the pressure within is diminished. The wall of the cecum is thin, inelastic, and under the greatest tension. It is probable that the cecal wall is often not elastic enough to relieve the pressure from within so that ischemia is prolonged and leads to small areas of necrosis. It is through such necrotic areas that perforation occurs.

Saeltzer and Rhodes[1] suggested the origin of cecal rupture in avascular necrosis and advanced confirmatory evidence from their observations. (1) Not infrequently there have been several openings in the cecum instead of one single opening. If rupture resulted from simple bursting due to pressure, the occurrence of one rent would release the pressure at once and prevent perforation at other points. (2) Most cecal perforations are found not where the wall is weakest but where the blood supply is poorest. Harris[4] demonstrated that the mesial aspect of the cecum, just above the ileocecal valve, is mechanically the weakest area, yet most perforations occur along the anterior surface. This is the antimesenteric border, hence least vascular. That was the site of rupture in the following case.

CASE REPORT

On July 31, 1941, a sixty-nine year old male was admitted to the Queen of Angels Hospital

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with the complaint of cramp-like pains in the lower abdomen of three days duration, associated with increasing abdominal distention and vomiting of gastric contents. He had had no abnormal stools, diarrhea, tenesmus or weight loss, but during the preceding several months, chronic constipation, present for years, had become progressively worse. There had been no satisfactory bowel movement for more than a week but there was still some passage of flatus.

Examination revealed a dehydrated elderly male with a tense, distended, tympanitic abdomen. The lower portion of the abdomen was somewhat tender throughout without any definite localization. Peristalsis appeared accentuated. No masses were felt. The hemoglobin and red cell count were slightly increased while the white cell count was 4,400 with normal differential. The urine contained a trace of albumin, acetone bodies and a few red and white cells. A plain roentgenogram of the abdomen revealed distended bowel loops in a pattern consistent with obstruction in the descending colon.

A soap suds enema given on admission yielded good fecal and flatus results, but subsequent enemas were ineffective. The patient refused operation at first but progressive deterioration of his condition and continued pain led him to change his mind after three days. At this time, the abdomen seemed more tense and distended, peristalsis was no longer audible and the pain had become constant instead of cramp-like in nature. The pulse rate had increased from 86 shortly after admission to 118 on the morning of operation and the patient's condition was obviously very poor.

Operation was performed on August 2, 1941, by Dr. Tepper. The initial incision revealed a diffuse foul smelling peritonitis which had apparently originated from a small perforation in the cecum. The opening was in the center of a rounded necrotic area about 1 cm. in diameter on the anterior wall of the cecum. All visible loops of small intestine, the cecum, and the ascending colon were markedly distended. A tube cecostomy was performed in the area of the perforation taking care to carry the purse-string sutures well out into the healthy bowel. Sulfanilamide was placed in the peritoneal cavity and in the layers of the operative incision.

Postoperatively, the patient became progressively worse with early signs of bilateral bronchopneumonia and terminal jaundice. Throughout the postoperative period, the cecostomy functioned well and the patient's distention decreased somewhat. Death occurred four days after operation.

At autopsy an obstructing adenocarcinoma was found at the splenic flexure of the colon. The rest of the large bowel including the region of the cecostomy was normal. Death was due to bronchopneumonia and parenchymatous degeneration of the liver.

CONCLUSIONS

Both in location and appearance the perforation in this case seemed to have resulted from local ischemia and gangrene rather than from tearing or bursting caused by pressure alone. The rupture probably took place during the period of delay caused by the patient's initial refusal of operation, yet there was no sudden dramatic picture such as is usually seen when a hollow viscus perforates.

The clinical signs did not at any time suggest a pathological process involving the cecum or appendiceal region. Some writers, however, have stated that the clinical picture in this situation may resemble acute appendicitis with perforation. The early picture in this case was that of large bowel obstruction but later signs were suggestive of a superimposed peritonitis.

Perforation of the cecum is one of the complications which may occur when operation is delayed in cases of large bowel obstruction. The rarity of this condition in recent years probably is due to the better treatment of intestinal obstruction which characterizes modern surgery.

SUMMARY

Rupture of the normal cecum may occur rarely as a result of obstruction of the colon distal to the cecum. A case report has been presented with a discussion of the probable mechanism.

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MULTIPLE ARGENTAFFINOMAS IN ILEUM WITH METASTASES IN LYMPH NODES AND IN THE LIVER*

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Gosset and Masson are the authors of our present day concept of those small, often multiple tumors of the gastrointestinal tract to which they gave the name "argentaffinoma." The literature is a reminder, however, that Lubarsch first described and recognized these tumors as being unusual, as far back as 1888. Ranson, in 1890, reported a small neoplasm in the submucosa of the ileum which had extended into the mesentery and through the peritoneum and secondarily involved the liver. The description corresponded to the picture associated with the argentaffin tumor but was considered by him as carcinoma. Obendorfer first suggested that they may arise from pancreatic rests but later demonstrated the chromaffic nature of the cells. Because of its similarity morphologically to carcinoma and its relative benignity he applied the term "carcinoid" to these tumors. Not one of his six cases of multiple tumors of the small intestine showed any evidence of local extension or distant metastases and all grew slowly. Krompecher and Bunting concluded they were related to the basal cell carcinomas. Forbus, in a thorough survey of the subject in 1925, was likewise impressed with their relative benignity and their possible endocrine origin. That they may often be malignant, has become more evident in reports of these tumors of late years. Obendorfer, in 1929, reported four cases in the ileum with metastases. Cook, Humphreys, Cameron, Möhl, and Wyatt all discussed their potential malignancy and added cases in support. Willis recently pointed to their malignant and metastatic propensities and reported six cases, in three of which he observed distant metastases. In a survey of the literature, Wyatt could find 159 cases of argentaffinoma in thirty-two of which there were metastases only to the regional lymph nodes and thirteen to more distant areas, chiefly the liver. This would indicate metastases in 28 per cent of all cases reported.

Masson clearly demonstrated that the silver reducing properties of the tumor cell coincided with those seen throughout the gastrointestinal tract in the Kulchitzky cells at the base of the crypts of Lieberkuhn. These reducing properties, he pointed out, corresponded to the functional state of the argentaffin cells and as a result some tumors could be completely free from them.

It is interesting to note that argentaffinomas occur most frequently where the Kulchitzky cells are normally found most abundantly. Thus the appendix and ileum are by far the commonest sites. They occur oftenest in the tip of the appendix and are approximately five times as common there as in the ileum. Humphreys found that about 30 per cent of those found in the small intestine were multiple. They are most often found incidently at autopsy or at operation, but the symptoms when they are present are referred to the appendix or intestine. Those in the small bowel rarely grow sufficiently large to cause obstruction by themselves but mesenteric metastases may give rise to adhesions or volvulus with resultant symptoms of intestinal obstruction.

Macroscopically, they appear to arise from the submucosa or mucosa, are firm,

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or rubbery in consistency, usually do not lead to ulceration of the mucosa, and most frequently vary in size from 0.5 cm. to 2.5 cm. in diameter. The sectioned surfaces appear homogeneous and yellow-ochre in color. Local extensions into the muscularis and often dimpling of the serosa may be observed. Microscopically, they are composed of columns or small nests of polyhedral cells, separated by a fibrous or muscular stroma. They show a remarkable uniformity in the size and staining reactions of both cell and nucleus. Mitotic figures are only rarely seen. In those that are functionally active acidophilic granules are seen which reduce the silver salts after the method of Masson. This author believes that the stroma results from hypertrophy of previously existing muscle bundles stimulated to proliferation by the presence of the newly formed tumor cells. Noteworthy, is the almost total absence of areas of necrosis in the primary tumor, and when present these are extremely minute, occur in the center of the nests and give the impression of acinar formation. The metastases reproduce both the structure and staining reactions of the primary tumor. The vascularity varies from case to case but is usually quite abundant.

Fig. 1. Photograph of argentaffinomas in ileum.

Fig. 2. Photographs of metastases in liver. Top: Note central necrosis and hemorrhage in large nodule. Bottom, left: Note scar of previous operation beneath tumor nodule. Bottom, right: Solid metastasis.

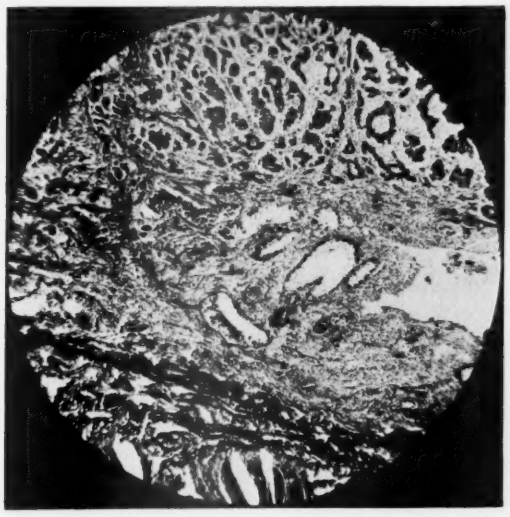

Fig. 3. Microphotograph of the tumor in the ileum. Note the normal crypts in the mucosa immediately adjacent to the tumor (hemotoxylin and eosin—× 80).

The case herewith reported demonstrates all these features and testifies to the presence of liver metastases for many years, death finally occurring from another condition.

CASE REPORT

B. K., a female, forty-four years of age, was admitted to The Jewish Hospital of Brooklyn on October 11, 1940, because of a cough of two days' duration, dyspnea, swelling of the abdomen and lower extremities, weakness, fatigue and a peculiar cyanosis of the upper half of the body of two years' duration. These symptoms were referred to a cardiac lesion from which she made exitus on November 3, 1940, and which Miilman will report. Related to the present discussion, however, is her more

remote history. In 1935, she was twice admitted to another hospital with menopausal symptoms, itchiness of the skin in the absence of visible jaundice and general weakness. Physical examination revealed an enlarged liver and during her stay she had several bouts of fever. She refused operation on the first occasion but returned later for a laparotomy. At that time an encysted soft mass medial to the gallbladder was drained. The material obtained was soft, friable and structureless and was reported histologically as necrotic tissue. From the material obtained no more specific diagnosis could be made. A sinus tract developed and persisted until closed surgically two years later. No symptoms related to the abdomen developed in the subsequent years. Her bowel habits had always been regular and she had never noted her stool to be black or blood streaked. On her last admission the stool on two occasions was strongly positive for occult blood.

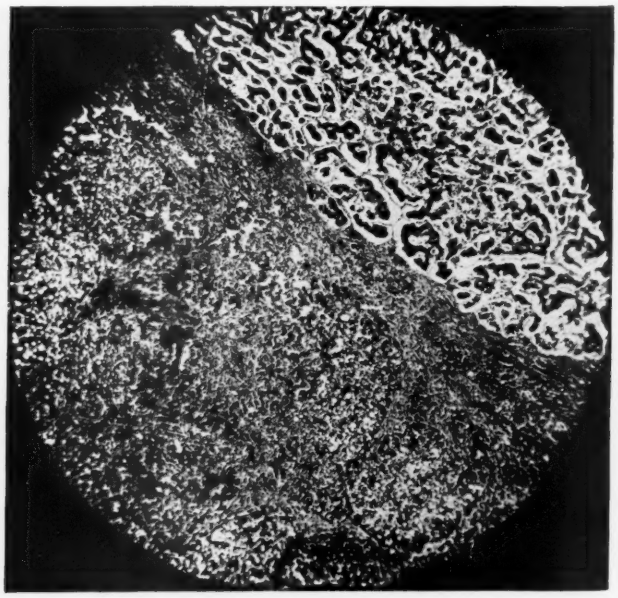

Fig. 4. Microphotograph of tumor metastasis in the liver. Note fatty changes in the liver cords adjacent to the tumor (hemotoxylin and eosin—× 90).

At autopsy the proximal ileum revealed six nodular masses contained within its wall. The largest measured 2 cm. and the smallest 0.2 cm. in diameter. Four were within the submucosa and projected into the lumen of the bowel with an intact mucosa covering them. One was pedunculated with pinpoint areas of ulceration in the overlying mucosa. The sixth nodule had a depressed center and firm rounded borders. (Fig. 1.) This extended into the muscularis and produced a dimpling of the serosa. All the tumor nodules were firm or rubbery in consistency and of a homogeneous yellow-brown or ochre-color in the sectioned surfaces. The appendix was not remarkable. In the mesentery of the ileum there was a firm spherical nodular mass measuring 3.6 cm. in diameter. On section it was similar in appearance to the nodules found in ileum.

The liver weighed 1,600 Gm. and measured 20 by 21 by 10 cm. At the inferior margin of the center of the right lobe there was a scarified construction with numerous adhesions to the abdominal wall and transverse colon. The liver also contained numerous tumor masses which measured up to 2.5 cm. in diameter. (Fig. 2.) One of these was fluctuant and presented at the dome of the right lobe. On section it was well circumscribed with a peripheral zone of yellow-brown rubbery tissue and a central area that was dark red, mushy and friable. The remaining nodules were firmer and of an ochre-color on section.

Microscopically, the tumor lay within the submucosa of the ileum. (Fig. 3.) In some cases the mucosa was denuded, and in one instance the nodule extended into and replaced the muscularis. It was composed of polygonal cells with well defined cytoplasmic borders, faintly granular acidophilic cytoplasm and uniform

oval nuclei. These cells were closely approximated and arranged for the most part in solid nests. The central portions of some were absent, suggesting an acinar arrangement. (Fig. 5.) Other areas showed a papillary arrangement with stalks of loose fibrous connective tissue bearing distended capillaries. Separating the islands of tumor cells was a stroma consisting of hyalinized fibrous connective tissue and some muscle fibers. Some of the cells presented dark granules within the cytoplasm, when stained by the technic described by Masson. The metastases in the lymph node were uniformly composed of cells in nests, separated by a fibrous stroma. In the liver, the cords of liver cells immediately surrounding the tumor were flattened and broken down. (Fig. 4.) Nests of cells similar to those seen in the ileum comprised the nodules but in some the central portion showed extensive hemorrhage and necrosis with complete loss of tumor structure.

Fig. 5. Same as Figure 3 under higher magnification (hemotoxylin and eosin—× 1200).

DISCUSSION

Many of the features commonly associated with argentaffin tumors are demonstrated in this case. The gross and microscopic appearance conforms with the usual descriptions as does the absence of large areas of necrosis in the primary growth. The argentaffilic granules are found only in a few of the tumor cells and is in keeping with Masson's contention that this is related to the functional state of the cells.

It is probable that the "liver abscess" drained four years before her death was in fact a metastatic nodule with central necrosis. This is borne out by the obstinate character of the postoperative draining sinus, and the presence of similar masses in the liver at autopsy. Despite this prolonged existence of metastases and of multiple primary lesions no remarkably clinical manifestation of the disease presented itself in the ensuing years. The patient died of a cardiac disease entirely unrelated to the condition described and their presence was unsuspected until found at necropsy.

SUMMARY

1. A case has been presented of multiple argentaffinomas in the ileum with metastases to the lymph nodes and liver.

2. The literature on the subject has been brought up to date.

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AMPUTATION OF A BUTTOCK FOR ERADICATION OF A CAVERNOUS HEMANGIOMA*

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CAVERNOUS hemangiomas of skeletal muscle and other tissues of the lower extremity are not rare and the subject has been covered in several detailed reports.[1,2,3] The following case is of interest because an amputation of a buttock was necessary for relief.

CASE REPORT

A twenty-nine year old woman entered the University of Kansas Hospitals January 14, 1939. In 1926, at the age of sixteen years, she first noticed a painless enlargement in the trochanteric region of the right thigh. This mass, which was said to be a lipoma, was excised five years later (1931) because of persistent gradual enlargement.

After two years (1933) there was recurrence of the tumor and a mass was also noted in the adjacent midgluteal region. These tumors slowly increased in size and in two years time (1935) became tender and painful. The pain was localized in the gluteal region in the beginning, but finally radiated down the posterior thigh, calf of the leg and into the heel. A second operation was performed in February, 1938. An incision was made through the old scar and the patient was informed that a "fatty and blood" tumor was removed.

This second operation afforded no relief from pain and, according to the patient, the mass in the buttock was still present. The pain progressed until the patient was bedridden most of the time.

One of the authors (M. J. R.) was then consulted and attempted a third operation, November 15, 1938. A longitudinal incision was made over the tumor mass in the buttock. A very extensive and invasive vascular tumor was found in the gluteal muscles which extended down to and encircled the sciatic nerve. Due to profuse hemorrhage, excision was deemed impossible at that time. A section of the neoplasm was removed and the pathological diagnosis from the gross and microscopic picture was "diffuse cavernous hemangioma of skeletal muscle."

The right buttock was much larger than the left. There was a tender, doughy, tumor mass which had apparently invaded the entire buttock and had extended below the gluteal fold. The superficial veins were very much enlarged over the mass.

A radical operation was planned and, with several suitable blood donors at hand, was carried out on January 15, 1939. An incision was made from the posterior superior spine of the ilium along the border of the sacrum and coccyx across the gluteal fold and thence lateralward. A large skin flap was turned back to expose the gluteal region. The gluteus maximus and medius, gemelli, pyriformis and obturator internus muscles were found to be infiltrated with a vascular tumor. These muscles were freed from their mesial attachments, dissected lateralward and removed in their entirtey. The mesial three-fourths of the gluteus minimus muscle and a considerable portion of subcutaneous fat were also removed. At the level of the gemelli muscles the tumor encircled the sciatic nerve and descended with it about three inches below the gluteal fold. The mass was dissected free from the nerve and was found not to infiltrate it at any point. The skin flap was then laid back and sutured in place.

There was considerable blood loss. Five hundred cc. of normal saline solution was given by the intravenous route and 1,200 cc. of whole blood as transfusion during the operation. The patient left the operating table with a systolic blood pressure of 60 mm. of mercury. She was given a transfusion of an additional 500 cc. of blood immediately upon her return to bed.

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The pathologist's diagnosis of the material removed at operation was "cavernous hemangioma of skeletal muscle."

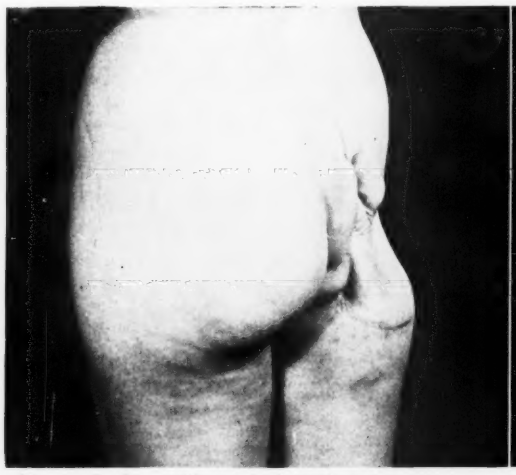

Fig. 1. Left semilateral view showing amputation of right buttock.

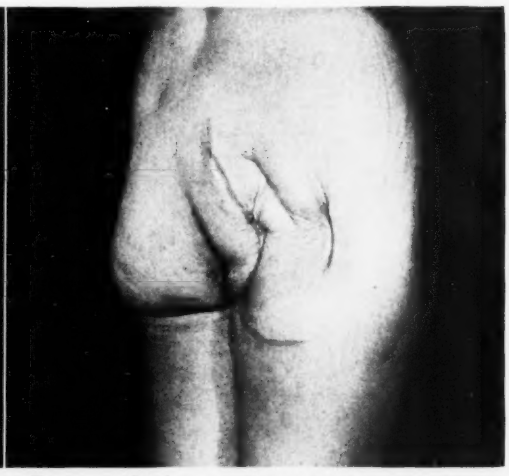

Fig. 2. Right semilateral view showing amputation of right buttock.

The immediate postoperative recovery was uneventful and the patient left the hospital on the seventh postoperative day. Thereafter a portion of the skin flap, about one inch wide and six inches long, sloughed along the longitudinal portion of the incision. This healed very slowly and was not materially improved by an attempt at secondary closure. Healing was complete at the end of eight months and relief from pain was complete.

The present appearance of the patient may be noted in Figures 1 and 2. The skin is adherent to the innominate bone and greater trochanter, but causes no discomfort except in sitting. This condition is relieved and the cosmetic aspect improved by the wearing of a sponge rubber pad attached to her girdle which fits over the affected area. To date (November, 1940) there is no evidence of recurrence.

The functional result is excellent. The patient walks with a barely perceptible limp and swims, dances and plays tennis with no difficulty.

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New Instruments

AN INEXPENSIVE ELECTRIC DRILL, SAW AND KIRSCHNER WIRE DRILL GUIDE

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HOLES can be drilled much more easily with an electric drill than with a hand drill. Bone grafts can be easily and quickly removed with an electrically driven saw. In some operative procedures, a bone saw is superior to any other instrument. The electrically driven drill and saw have a definite place in the surgeon's armamentarium. There are many motor drill and saw sets on the market. Since all of them are expensive, we have devised the following:

ELECTRIC MOTOR HAND DRILL

There are numerous electric hand drills available for work other than surgical. These machines give good service and withstand considerable abuse. About five years ago we first attempted to use ordinary electric drills in our surgical work. The first motor functioned satisfactorily and withstood sterilization by baking very well. This motor was larger and more powerful than necessary. It also was a high speed type, consequently one of us (L. W. B.) began to use a small electric drill. (Fig. 1.) This drill turns at a low speed. It can be stopped during full speed by strong pressure of the fingers on the rotating chuck without danger. Even so it has sufficient power to operate any size bone drill or saw. It has a handle and can be held securely and in a balanced position for all types of work. This motor has functioned satisfactorily for four years in continuous use.

Three changes were necessary before this drill was first used in the operating room. First it was dismantled. The outer shell and metal fixtures including all parts of the chuck were plated with nickel. At the electric motor repair shop, the armature wiring was painted with insulating enamel and baked in order to provide adequate resistance to moisture. A three wire cable was substituted for the conventional two-wire cord so that the motor could be grounded during operations. The dangers resulting from a short circuit were thus avoided. The finished product has the appearance of a good surgical instrument and can withstand steam autoclaving.

DRILL POINTS

These were purchased from the local dime store. In our experience they do not break as easily as the high carbon variety. A complete set can be obtained at an amazingly low price.

SAW

Two blades were purchased from a surgical supply house. One blade had a diameter of one and one-half inches. The other had a diameter of three-fourths of an inch. The spindles were designed for the motor, and a machine shop manufactured them exactly as we desired.

KIRSCHNER WIRE DRILL GUIDE

A motor driven drill point operates much better than a drill point which is driven

manually. Therefore, an attempt was made to devise an attachment by which a Kirschner wire could be driven smoothly in place. The collapsible out rigger type of guide for a Kirschner wire is at times cumbersome and difficult to operate in a small incision or near another wire. The following instrument was therefore designed:

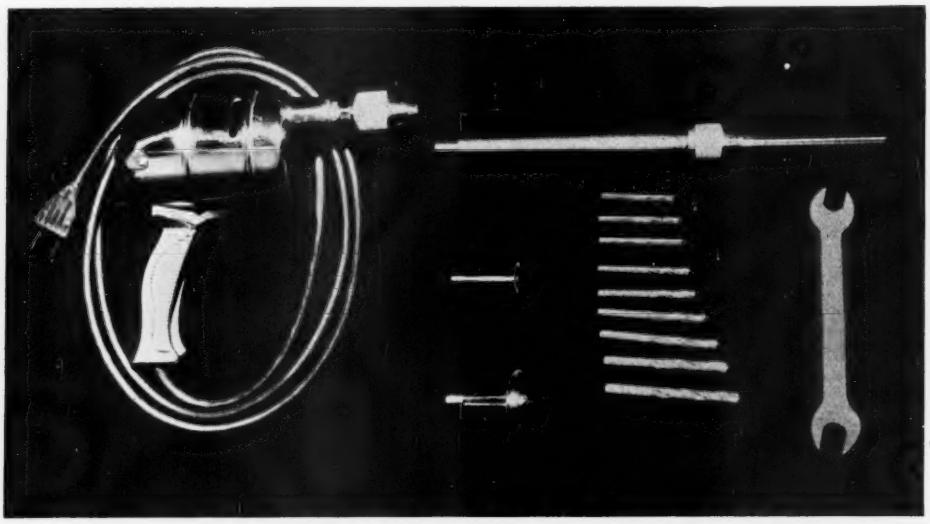

Fig. 1. Photograph of the electric drill with the large and small circular saw attachments, a set of drill points, a wrench to stabilize the motor shaft when the chuck is being tightened. At the upper right is pictured the Kirschner wire drill guide instrument with a Kirschner wire in place.

This instrument was made from a rod of iron, which was seven inches long and three-eighths of an inch in diameter. A hole one-eighth inch in diameter was drilled throughout its entire length. From the dime store, a small chuck was purchased and all of its parts were plated with nickel. Threads to match this chuck were cut on one end of the iron rod. On the other end of the rod, the diameter was reduced to one-fourth inch for a distance of one-half inch so as to adapt the rod easily to the chuck of the electric drill. Thus when this instrument is fastened to the motor, there is formed a long hollow shaft into which the Kirschner wire can be placed. The small chuck on the end of the rod can be tightened and the wire is thus firmly held. The average wire, when fully sunk into the Kirschner wire drill guide extends from two to three inches beyond the chuck of that instrument. This small length of wire does not "whip" during rotation. In fact we usually allow the point of the wire to project that distance beyond the chuck of the Kirschner wire drill guide when wire is first being drilled into the bone.

This Kirschner wire drill guide will also fit the average hand drill and can be operated manually if desired.

There are three imperfections to this instrument: First, the Kirschner wire must be gripped along its shaft by the chuck. This part of the Kirschner wire must necessarily be round. Thus, if the chuck is not tightened firmly, it will slide around the wire. If all parts of the chuck are kept smooth and lubricated, it will function satisfactorily. Second, after the wire is drilled in up to the chuck it is necessary to loosen the chuck, slip a short length of wire out of the instrument, and re-tighten the chuck if the wire must be drilled deeper than three inches. Third, the shaft of the motor has a slight degree of instability. During the operation of the drill point or

saw blades, this is not noticeable. However, the Kirschner wire drill guide extends the shaft for sufficient distance to cause the point of the wire to form a small circle during rotation. If the wire point is placed into the tissue to be drilled and then put in motion, this factor likewise is unimportant.

The small number of imperfections can be tolerated easily when one considers that the whole expense amounts to only $26.25.

CONCLUSIONS

A satisfactory surgical instrument has been constructed from an ordinary electric hand drill.

An account was given of steps necessary to procure drill points and saw attachments.

A Kirschner wire drill guide was presented.

The cost of the complete set was only $26.25.

ANKYLOSIS of a joint or stiffness of the adjacent soft parts is due not to immobilization but to pathologic changes. Such changes in turn are due to irritation, inflammation, issue destruction, and scar formation.

The brief exerpts in this issue have been taken from "Wounds and Fractures," by H. Winnett Orr (Charles C. Thomas).

A POSITIVE SHOULDER LIFT FOR FRACTURED CLAVICLES

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IN fractures of the clavicle the difficulty has been the inability to lift and hold the shoulder in the up, out and back position necessary to bring the bone ends into apposition. It is quite apparent that to accomplish this purpose the lifting power must rest upon an unyielding base.

FIG. 1. 1, strap hook; 2, universal angle splint; 3, lifting straps; note position under the connecting links and around the splint troughs.

The device illustrated possesses those factors that will permit practically an anatomical apposition of the bone ends. The fundamental feature is the placement of a metal ring fitted to the individual diagonally around the thorax cage of the affected side. This ring is composed of two semi-elliptical pieces. They can be shaped by hand to fit a thin or stout person. The axillary piece has holes uniformly spaced along its length. The shoulder piece has screw pins rivetted on its ends. These are to engage in the appropriate holes in the axillary piece.

The elements of this instrument are a chest ring, a strap hook with two straps attached and a universal angle splint.

In assembling this instrument the axillary semi-elliptical ring is laid comfortably high in the axilla with the ends pointing to the opposite shoulder. The shoulder ring piece is placed in the angle of the neck with the ends overlapping the ends of the axillary piece. The particular holes on the axillary piece with which the screw pins on the shoulder piece mate are noted. The ring pieces are now removed and the posterior overlapped sections are connected. The screw pin is inserted in the mating hole and a nut holds it secure. The other end is bound with adhesive

plaster. The anterior overlap is not connected at this time as it is left open to spring the ring into position on the chest. The strap hook is inserted in that hole in the axillary piece which will give the correct directional lift to the shoulder.

Except for the anterior overlapping portion the ring is padded with a strip of felt held on with an artificial leather bandage. The anterior overlapping ends are opened to permit springing of the ring into position on the chest. The anterior overlap is now connected as was done posteriorly. The padding is then completed on this section. The ring is coated with petrolatum.

The universal angle splint is angulated and the connections screwed tight to hold the arm in the Velpeau position. It is padded and held to the arm and forearm with adhesive plaster bands.

The lifting straps from the hook are passed to the inside of the connecting links of the splint and around the medial sections of the arm and forearm splint troughs.

The shoulder is now raised to the correct position and so held with the lifting straps.

Should there be any uncorrected uplift of the clavicle, it can be brought into place with a padded plate held down with adhesive bands attached to the ring front and back.

In a separation of the clavicle from the acromion process this instrument is of outstanding value. The plate laid over the clavicle and drawn with adhesive straps to the ring holds the clavicle against the upheld shoulder in permanent apposition with the acromion process.

The following are the specific features of this instrument: (1) The weight of the arm is held up with no drag and no discomfort. (2) Moderate movement of the shoulder joint is permissible during the treatment. (3) The instrument moves synchronously with respiration, thus maintaining the positional relations of the parts. (4) Body movements are not restricted. (5) There is no injurious trespass upon vessels or nerves. (6) With a properly placed lift of the shoulder, the bone ends come into practically anatomical apposition. (7) Particularly in acromioclavicular separations the two bones can be brought into and held in fine contact. (8) The instrument may be of service in fractures of the scapula.

Almost needless to say, for best results, fracture deformity reductions are emergency propositions.

Selected Book Reviews

TWO outstanding works that are "musts" for medical students and a majority of practitioners, are Alfred C. Beck's* "Obstetrical Practice" and Henry A. Christian's† "The Principles and Practice of Medicine."

The first edition of Beck's "Obstetrical Practice" was published in 1935 and was reprinted in 1936. It enjoyed an instantaneous success. We personally know of a medical student of one school who visited a student of another school. This student had Beck's book and the first student was so impressed he bought a copy. In two weeks' time half of his classmates owned copies. In 1939, the second edition came out. This was reprinted in 1941. In 1940, the first Portuguese edition was published. And now we have an enlarged and in many parts, a rewritten third edition.

For nearly thirty years Beck has had the reputation of being one of *the* great obstetrical teachers. There are many kinds of obstetricians; there is the man who is a "book and/or research" obstetrician. As a clinical worker usually he leaves much to be desired. We know of a late obstetrician, famous throughout the civilized world, who made you wince when he attempted to do a low forceps extraction. Then there is the man who has little scientific background or a thorough basic training, but who, nevertheless, has what we call "good hands." He is expert in doing a podalic version, converting an impacted face into a vertex or one of the various methods of cesarean section. Some can impart knowledge and some are mute on this score. Dr. Beck combines all three of these men. He can and does teach; he has the scientific background and knowledge, and he is a skillful operator. In addition, he wrote the book first hand and, ever keeping the student in mind, fashioned it to fit his needs.

* Obstetrical Practice. By Alfred C. Beck. M.D. Third Edition. Baltimore, 1942. Williams & Wilkins Company. Price $7.00.

† The Principles and Practice of Medicine (Originally by Sir William Osler). By Henry A. Christian, M.D. Fourteenth Edition. New York, 1942. D. Appleton-Century Company. $9.50.

In many instances previous chapters have been rewritten and brought up to date. The arrangement is logical and practical. The drawings are outstanding and are a great aid to the text, and these

FIG. 1. Three figures from a series of twenty-four drawings which summarizes the L.O.A. mechanism. (Figures 202, 203 and 204 in Beck's "Obstetrical Practice." Williams & Wilkins Company.)

drawings are different, inasmuch as Dr. Beck has devised a new method for the use of color. There are seven chapters on operative obstetrics. We learn the proper way to prepare the parts for a cesarean operation under local anesthesia, various technics of cesarean section are given in detail, as are the Porro operation and the Waters procedure. This book now has grown to 938 pages; there are a 1,064 illustrations, a bibliography at the conclusion of each chapter, and an ample index.

The publishers are to be commended for offering this textbook at a remarkably low price. Many outstanding men who know values and know what they are talking about declare Beck's "Obstetrical Practice" the best work of its kind to date in the English language.

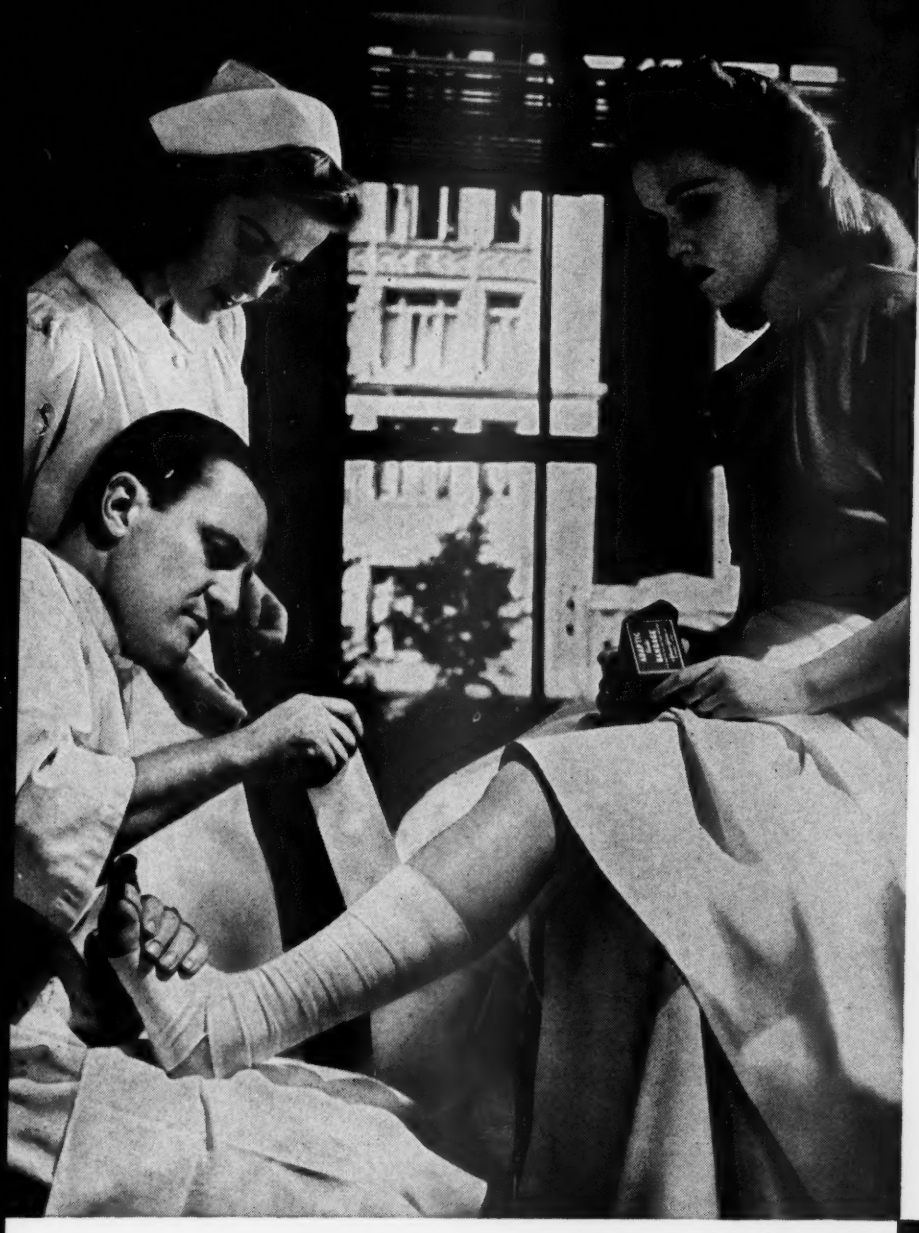
Fifty years ago William Osler wrote his "Principles and Practice of Medicine." Naturally such an outstanding work would continue after its creator had passed on. First, Thomas McCrae was the editor who carried on from edition to edition, and then Henry A. Christian occupied the chair. Both worked with Osler in their early days; both have been leaders of medicine in their own right; each of them incorporated his own knowledge and personality and kept the work alive and up-to-date. This edition, celebrating its semi-centennial (1892–1942), is no longer truly Osler's or McCrae's or Christian's volume, but an accepted standard work by Osler, McCrae and Christian.

"The text remains in a large measure the portraiture of disease as it has been observed by three authors against a background of publications embodying the periodic advances in medical knowledge made by medical men the world over."

This edition was published to bring up to the minute the many new methods, agents and important new material that goes hand in hand with medical progress.

This the fourteenth edition (1,475 pages, a working bibliography at the end of each chapter, and a more then adequate index) goes into the later methods of treatment, especially chemotherapy, increased emphasis is placed on the functional aspects of medicine, the subjects are rearranged into more logical sequence, epidemiology is stressed, necessary pediatric considerations are included, and newly identified diseases are discussed.

Dr. Christian has done a marvellous book. After all, this work needs neither introduction nor a review in the ordinary sense of the word. It is a recognized medical classic and Dr. Christian in keeping it one of the great medical classics has made for himself a name that will go down the years when all who now walk upon this earth will have departed.



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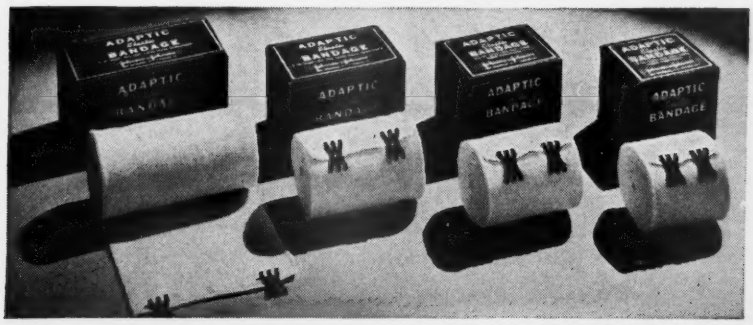

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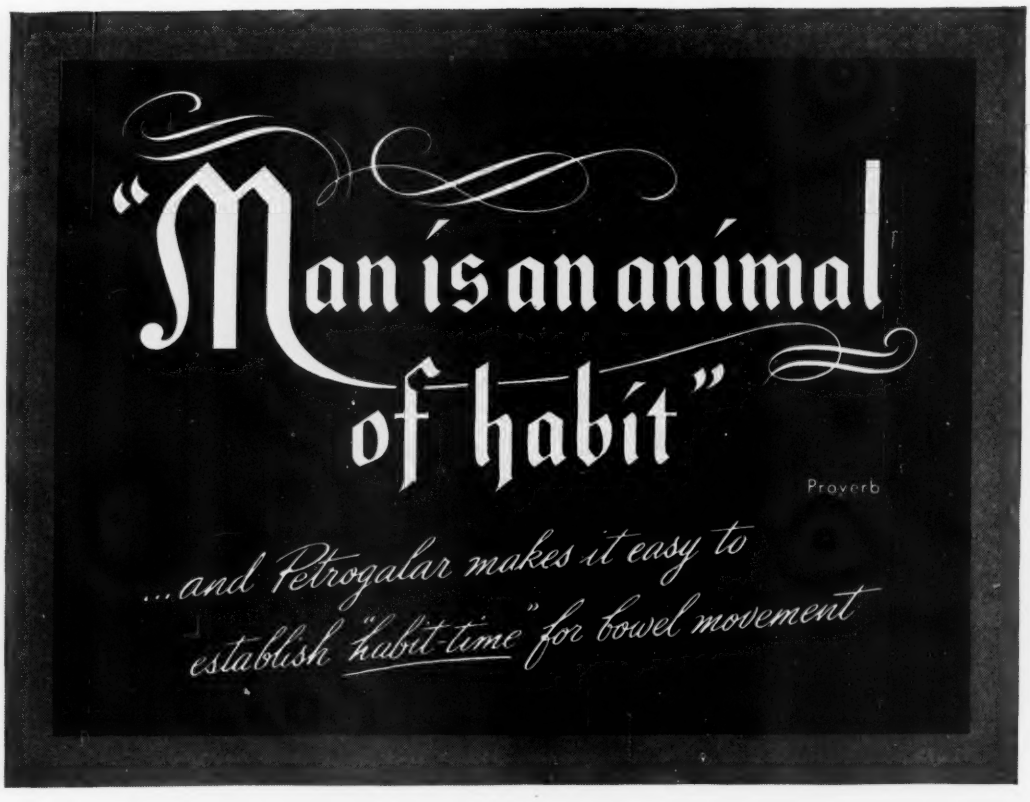

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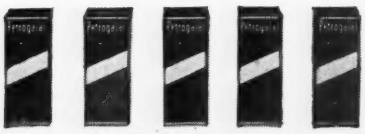

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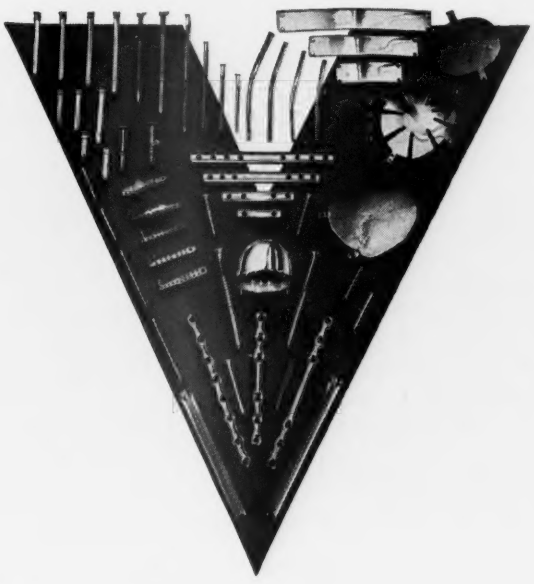

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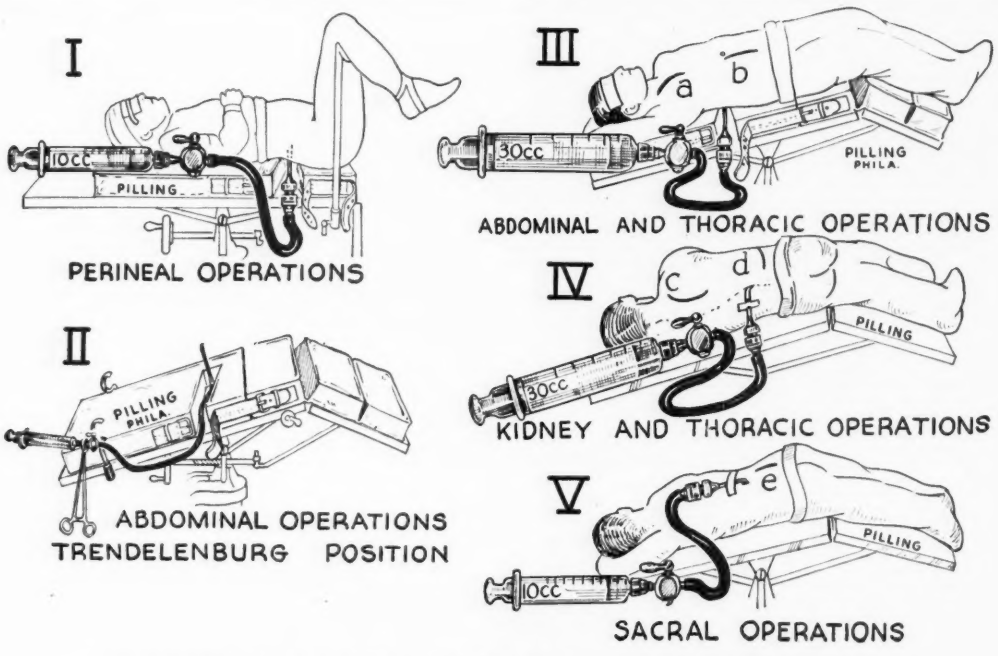

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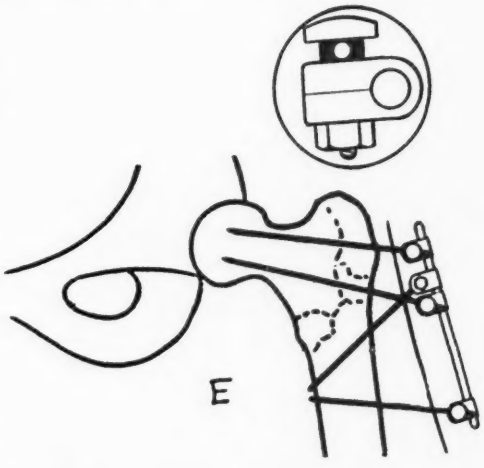

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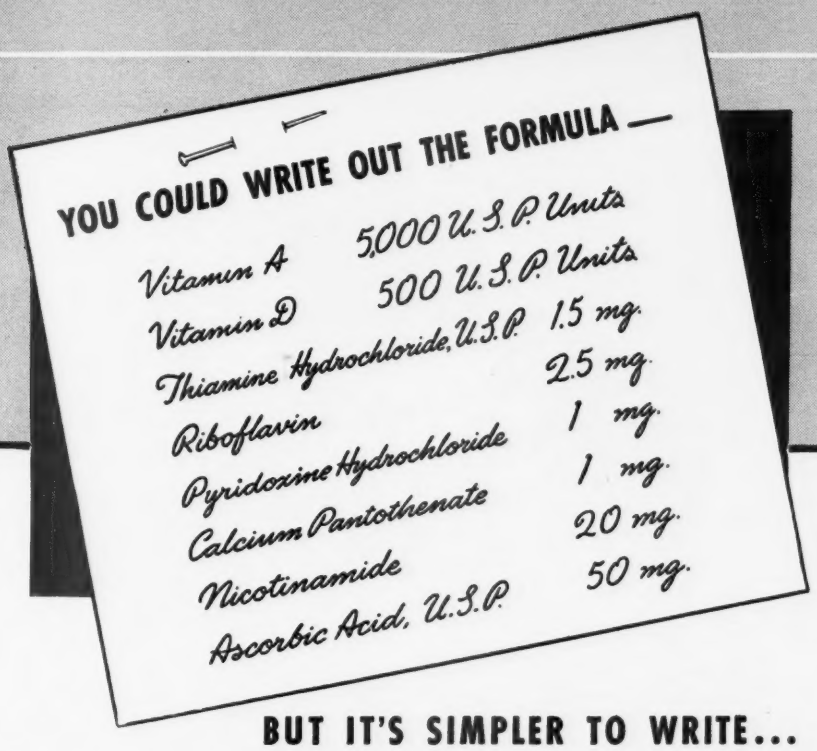
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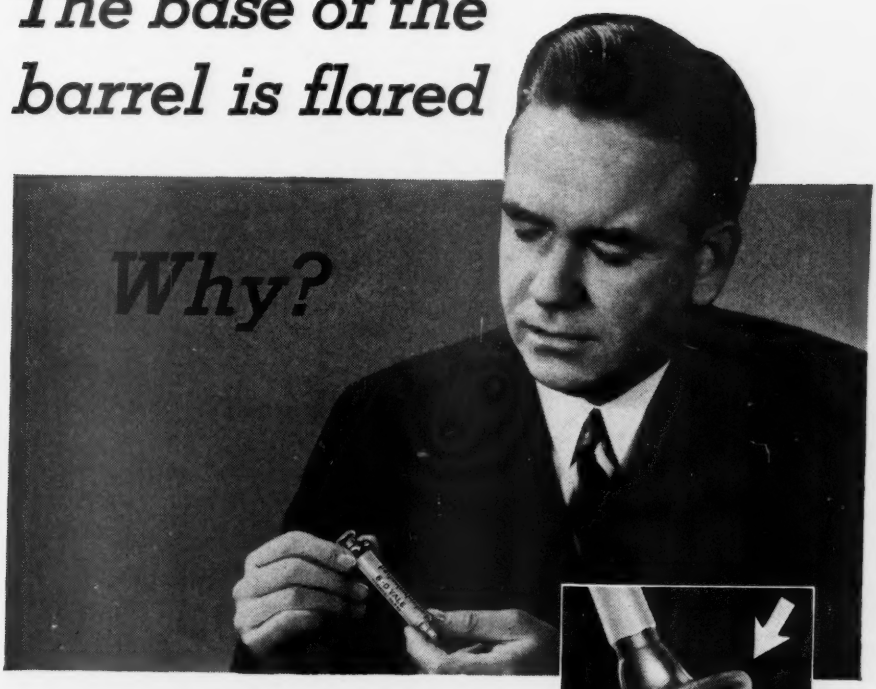

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W. A. Baum Co., Inc.	27
Becton, Dickinson & Co.	31
Crescent Surgical Sales Co., Inc.	12
General Electric X-ray Corp.	*March*
Fred Haslam & Co., Inc.	30
Picker X-ray Corp.	9
Geo. P. Pilling & Son Co.	28
Singer Sewing Machine Company	5
J. Sklar Manufacturing Co.	11
The Tower Co., Inc.	28
Edward Weck & Co., Inc.	22
Zimmer Manufacturing Co.	*March*

Sutures

Davis & Geck, Inc.	*Insert Facing 2nd Cover*
J. A. Deknatel & Son, Inc.	10
Gudebrod Bros. Silk Co., Inc.	30
Johnson & Johnson	*March*

Pharmaceuticals

Abbott Laboratories	20
Alba Pharmaceutical Co., Inc.	21
American Hospital Supply Corp.	25
Arlington Chemical Co.	*March*
The Armour Laboratories	*Insert Facing Page 8*
Ernst Bischoff Co., Inc.	32
Carbisulphoil Company	*March*
Ciba Pharmaceutical Products, Inc.	*4th Cover*
Cutter Laboratories	*March*
E. Fougera & Co., Inc.	19
Hoffmann-La Roche, Inc.	6
The Lavoris Company	*March*
Lederle Laboratories, Inc.	*March*
Thos. Leeming & Co., Inc.	1
Eli Lilly and Company	*March*
Merck & Co., Inc.	*March*
The Wm. S. Merrell Company	16, 17
National Drug Co.	15
Ortho Products, Inc.	34
Parke, Davis & Co.	*March*
Petrogalar Laboratories, Inc.	26
Rare Chemicals	*March*
Schering & Glatz, Inc.	*March*
Schuylkill Chemical Co.	*March*
E. R. Squibb & Sons	14
The Upjohn Co.	*March*
Wallace & Tiernan Products, Inc.	18
William R. Warner & Co., Inc.	33
White Laboratories, Inc.	13, 29
Winthrop Chemical Co., Inc.	2

Hospital Supplies

Bard-Parker Co., Inc.	*March*
Becton, Dickinson & Co.	31
Crescent Surgical Sales Co., Inc.	12
Cutter Laboratories	*March*
General Electric X-ray Corp.	*March*
Fred Haslam & Co., Inc.	30
Johnson & Johnson	23
Macalaster Bicknel Company	8
Mallinckrodt Chemical Works	7
Massillon Rubber Co.	32
Picker X-ray Corp.	9
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Cook County Grad. Sch. of Med.	24
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